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## CONTENTS.

An Asterisk (*) denotes an illustrated article.


OFFICIAL NOTICE—
Eighteenth Annual Meeting American Gas Light Association..... 325

EDITORIALS—
The Savannah Convention..... 326
*Retorts Contracted at the Back End, by Mr. J. B. Terrace..... 327
Cyanogen in Gas Making..... 327
Notes on Gas Lighting and Gas Fitting, by Mr. William Paul Gerhard, C.E.—Continued from page 295..... 328
Classification of Incandescent Lamps..... 330
Novel Method of Raising Water from a Shaft..... 331
*Phenomena of Alternating Current Induction, by by Prof. Elihu Thomson..... 332
Something about Quicksands..... 334
French Practice in Creosoting Railway Ties..... 334

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 335
Obituary: Prof. Silas H. Douglas—Something about the Hotel De Soto and the City of Savannah—Annual Election, Lincoln, Neb.—Cheaper Gas for Quincy, Ills.—Rise in Price of Refined Ammonia—Fuel Gas at the Beaver Falls (Pa.) Works of Carnegie, Phipps & Co.—Street Lighting, Deerpark, N. Y.—The Queen City Company—How Chicago Treated a Demand from the Hyde Park Company—Mr. Whittier's Contracts—Annual Meeting, Providence, R. I.—Reorganized at Wakefield, Mass.—Equity Gas Works Construction Company—And Many Other Items.

Shall We Bake and Cook by Electricity?..... 337
The Market for Gas Securities..... 337


[OFFICIAL NOTICE.]

### Eighteenth Annual Meeting of the American Gas Light Association.

EXTRACT FROM THE CONSTITUTION:—Sec. 12. *Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least ten days prior to the meeting at which the application is acted on.*

SECRETARY'S OFFICE, Aug. 25, 1890.

*To the Members of the Association:* Gentlemen—The rapidly approaching autumn serves to remind us that the time for the Eighteeenth Annual Meeting of our Association is drawing rapidly near, and it is therefore proper that I should inform the members of the arrangements which are being consummated, whereby we hope the meeting will be made one of the most successful gatherings we have ever had; certainly it deserves to be such, for it will be the first time we have ever gone to the extreme South to hold our annual convention. Already there are indications that the coming meeting will be a very large gathering, and it is proper and natural that it should be; for as many of our Southern members have been very faithful in their attendance at our annual gatherings, when held at the North and in the West, it is but just courtesy that the brethren from the cooler sections of our territory should make an extra effort to be present on this first occasion of our coming together in the South. And, further, the South is a section of the country through which many of us have not traveled so thoroughly as we have in the North, and it is therefore but natural that we should all be only too anxious to improve this opportunity to make ourselves better acquainted with Southern people and the Southern land, for the novelty of the surroundings in the South will add a peculiar charm to our trip.

Savannah is a typical Southern city, and one particularly suited for the holding of our convention. Situated on the south of the Savannah river, and within 12 miles in a straight line from the coast, it has many advantages of both an inland and seaboard city. The river in Tybee Roads has a depth of 31 feet at low water, thus admitting the ocean steamers to come up direct to the wharves of the city; hence it will be possible for such of our members living in the vicinity of Boston, New York, and Philadelphia, who enjoy an ocean sail, to take a steamer from either of the cities named and land right at the heart of the city.

Savannah is a very pretty city and has many attractions peculiar to itself; laid out as the streets are in rectangular lines, they are pleasantly broken by many small but pretty parks—in fact there are between 20 and 30 of these attractive gardens scattered throughout the city. In the southern part of the city is Forsyth Park, with a fountain after the model of that in the Place de la Concorde, Paris, and a monument to the Confederate slain. Johnson Square contains a doric obelisk of General Green and Count Pulaski, the corner stone of which was laid by Lafayette; and in Monterey Square on the spot where Pulaski fell, in 1779, rises a more elaborate monument—a statue of Liberty. Many of these parks are semi-tropical in their vegetation, and will have to many Northerners the charm of novelty; and in this connection should be mentioned Bona-Venture Cemetery, with its live oaks dressed in Florida moss—at once a beautiful and novel sight. It is also to be noted that Savannah is one of our largest cotton shipping ports, and our members will have

the opportunity of seeing the loading of cotton vessels going on with all its hustle and bustle; the sight of men stowing away a cargo of cotton, with the help of huge jacks, will certainly be new to many of the visitors. We will also be fortunate this year in having hotel accommodations such as we have not had at any previous convention. The De Soto—the headquarters selected—is a new hotel and is a good rival of the magnificent hotels which have lately been built in the South. The De Soto occupies a prominent corner in the central part of the city, in fact covers the site on which—as old army men will well remember—stood the old arsenal used as the headquarters of the Union forces during Sherman's occupancy of the city, and is built in the form of a hollow square, in the center of which is the parade ground; the front of the building measures 222 feet, while it extends 302 feet to the rear; the dining hall, which is beautifully finished, is 44 feet by 120 feet, and looks out upon Liberty and Drayton streets on two sides, the windows of the third side opening out upon a veranda overlooking the parade ground and tennis courts. The service of the hotel will also be of the best; the committee of arrangements are giving this matter particular attention, and, as the house will not be at all crowded, members can depend upon finding everything thoroughly comfortable. The rate which has been secured at the hotel for the members of the Association and their friends is $3.50 per day, board included, with a discount from this price if the attendance is large. It is hoped that all the members will stop at the De Soto, because by so doing they will help to swell the number and thus aid in securing the lowest rate. It is to be remembered that though the rate is thus made very low—considering the character of the hotel—nevertheless the accommodations will be first-class and such as they would offer to their regular guests. It is hardly necessary to add that private parlors and bath rooms will be charged for extra, as is the case in any American conducted hotel.

I have thus gone into a description of the hotel with more than regulation precision, because I fear some of the members may feel that as Savannah is not a city of the first magnitude, the hotel accommodations might be of an indifferent nature; whereas the fact is we may expect to be taken care of far better than we have been in the past, even in the largest cities. The meetings of the Association will be held in the spacious banquet hall on the top floor of the hotel; we will thus have both a cool and a quiet hall.

The meeting will be called to order by President McMillin, on Wednesday, October 15th, at 10 A. M., and will continue through the two following days. The papers already promised are as follows:

"The Extension of the Use of Gas for Purposes other than Illumination," by E. G. Pratt, of Des Moines, Ia.

"The Mismanagement of Gas Works," by E. G. Cowdery, of Milwaukee, Wis.

"Gas Coals of the United States," by H. C. Adams, of Philadelphia, Pa.

"The Practical Efficiency of an Illuminating Water Gas Setting," by A. G. Glasgow, of Philadelphia, Pa.

"Inclined Retorts," by Frederic Egner, of St. Louis, Mo.

From the above it will appear that we have already five good themes for special study and discussion, and we expect three more papers, the subjects to be announced later. In this connection I would say that if a member has any matter upon which he would like to write a paper, we can probably find room for one more essay. I would also issue my usual invitation for members to send in queries for the question box; it is well to have these in advance in order that we may have some one prepared to lead off in the discussion.

On the evening of Thursday, the second day of the meeting, the Association will be the guest of the Savannah Gas Company, at a banquet which will be given at the De Soto; it is expected that in addition to the members of the Association there will be present many of the leading citizens of Savannah to grace the occasion. Efforts are being made to have a river excursion on the last day of the meeting.

We expect to have the regular rebate on railroad rates, particulars in regard to which will be given later, when I have received detailed information from the railroad authorities.

I wish to impress upon the members that Savannah is easy of access from most of the large cities of our country; for instance, leaving Boston at 7 o'clock Sunday night, we would pass through Washington at 11 the next morning, reaching historic Richmond at 2.30 the same afternoon; an hour later we reach Petersburgh, ever famous since the war; Charleston we will see by the early daylight, and at 6.44 Tuesday morning we should be at Savannah. Or those who do not care to spend so much time away can leave Boston Monday night and reach Savannah a few hours before the opening of the convention. Leaving New York at midnight of Sunday or Monday, Savannah would be reached on Tuesday or Wednesday morning respectively; while the run from Philadelphia takes less than 24 hours. From Chicago one route is over Illinois Central to Cincinnati, thence by Queen and Crescent, Western and Atlantic and Georgia Central; time 39 hours. Time from Cincinnati, 34 hours. From St. Louis, via Louisville and Nashville, and Nashville, Cincinnati and St. Louis, and Western and Atlantic, and Georgia Central; time 34 hours.

Thus it is apparent that the run to Savannah from the centers, at which the members will be apt to congregate before starting South, is not a long one, and as the route much of the way lays through interesting sections of the country, with pine forests and beautiful rice fields, and through p aces made historic by the war, the journey ought to be a pleasant one. If the members desire to charter special cars, I will gladly help them in any way I can. Or those preferring an ocean trip can take one of the ocean steamship company's vessels from New York or Boston and land right at the city, the trip taking from 48 to 55 hours. The rate by this route, including meals and berth in state room—first-class—is, from New York $15, or $25 for the round trip; from Boston the rate is $17 one way, or $29 for the round trip. Those desiring to secure these special rates must obtain a proper certificate from me.

Finally, I wish to urge upon each and every member that he endeavors to be present and make this meeting a grand success. We meet for the first time in the South; we have for our President one of the most popular men of the West; these two facts should lead all to make an extra effort to attend. Not only so, but it is particularly desired that the members will bring their ladies with them, as the committee are making special arrangements for their entertainment. Already a local committee of reception has been appointed from among the hospitable ladies of the city, so there will always be escorts at hand to show the attending ladies the places of interest throughout the city, of which there are many more than I have space to enumerate. Anticipating the attendance of a large number of ladies, the hotel proprietors have placed at the disposal of the local committee of ladies the large parlors at the Bull street entrance of the hotel, and they will be for the exclusive use of the ladies attending the convention. In fact it may be said the entire hotel will be at the disposal of the members and their friends.

Yours truly, C. J. R. HUMPHREYS, Sec'y.

LAWRENCE, MASS.

## THE SAVANNAH CONVENTION.

With this issue of the JOURNAL we print the first official announcement from Secretary Humphreys respecting the Eighteenth Annual Convention of the American Association, and we must congratulate him on the cleverness with which he has set out the many attractions that Savannah has for the visitor and guest. Beyond a doubt it is one of the most charming cities in the South, and the contrasts that it presents are absolutely novel. The very contrasts, however, serve most eloquently to tell of the "Old South" that was and the "New South" that is, the latter a successor to an inheritance which shall, by the thrift of her people, raise her to a prouder prominence than that ever enjoyed by her during the indolent period of the ante bellum times. It is useless for either the East or West to blink the fact that their Southern sister has emerged from the indolence (perhaps restfulness would better express it) of the olden days, and even now successfully competes for a share of the nation's commerce that grows larger, actually, day by day. Pit and railway, furnace and storehouse, factory and counting room, public institution and residence, are telling evidences of the mighty impulses that actuate her people, and that say to the world the "New South" shall conquer. We can, however, but say to our readers that if they want to see these things put to the proof, let them journey to Savannah next October, either as members or guests of the American Association. The persuasiveness of the local committee must be of a very superior order, when one sees that they have induced the management of the new and magnificent De Soto House to open that hotel some weeks in advance of the time originally intended, simply for the accommodation of the American Association. In another column will be found some remarks (Item columns, correspondence from "D. H. C.") respecting the De Soto, which, taken in connection with Secretary Humphrey's reminders, will prove that kings never had better "castling" than is to be the portion of the Association.

Even if another paper be not added to the published list, the members may count on having the time allotted to the business portions of the sessions fully and profitably taken up. They may also rest assured that their Secretary will be out in time with the announcement of a substantial concession in railroad rates for their comfortable and safe transportation. Especial attention should be given to the extract from the Constitution of the Association, that heads the preliminary notice. Every member should take it upon himself to convince the nearest one to him that is eligible for membership that he should join the ranks at Savannah next October. Unity means victory; and that is what we all desire to achieve. Southern hospitality means everything that the word implies. By all means, then, get ready for Savannah.

[A Paper read by Mr. J. B. Terrace, of Brechin, before the North British Association of Gas Managers.]

## Retorts Contracted at the Back End.

When I introduced this subject to your notice some time ago at an nformal meeting in Glasgow, many of your number did not have an opportunity of taking part in the discussion. I therefore consider it my duty to bring it forward on the present occasion, with the hope that it will receive your united attention; and it will be my endeavor to lay before you my experience in the cleaning or scurfing of an ordinary retort in comparison with that of the improved shape I have adopted.

The works in which I have been engaged for the past six years were remodeled from plans prepared by the late Mr. John Reid, of Leith; and they contain a single retort bench of six ovens, with four Ω-shaped retorts, 22 in. by 14 in., and 9 ft. long, in each. The cleaning of our retorts had been looked upon as a very difficult and troublesome operation, until about three years ago I determined to make a trial of the retort contracted at the back end. For this purpose I ordered four, and had them built into separate ovens, so as to enable me to compare them better working alongside the ordinary retorts; because if I had placed all four in one oven it would have been impossible to give them special attention. I had two of the retorts placed in the lower bed, and two set as top retorts, in separate ovens, as mentioned above, because, whether with the ordinary or the improved shape, the lower retorts are always more easily cleaned than the top ones. I may mention here that new retorts also are easier to clean the first time than on any succeeding occasion. When we were under the necessity of spending from 12 to 15 hours trying to clean an oven of four retorts, it need not be wondered at that some attempt should be made to simplify matters, and reduce to a minimum the hard work the men had to perform.

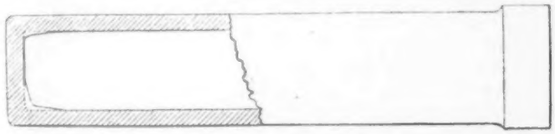
In preparing to clean our retorts we close the furnace damper of the oven, remove the coke, and replace the lid so as to keep it about half an inch clear of the mouthpiece, to admit cold air at the bottom and allow the exit of hot air at the top opening for from 24 to 30 hours, as required. During the interval the furnace fire is kept burning, so as to maintain a regular heat on the oven. Great care is exercised to see that no loose portion of the retort falls out, as often occurs with retorts which have been a long time in use and are slightly damaged; for should furnace air pass through the retort, it will be cooled rapidly and damaged, should the defect not be noticed and repaired at once. In cleaning we employ long steel chisel-bars of 1¼ inches diameter, 17 feet long; and in the case of the ordinary retorts we endeavor to cut the cake or shell of carbon at the back into two or more parts. Should this operation prove unsuccessful, the carbon is often chiselled off in very small pieces. But even by this process it cannot be removed from some of the corners, as the surface of the carbon becomes smooth and bevelled, so that no chisel bar can remove it without the use of some kind of bracket placed inside the retort, so as to prevent the point of the chisel sliding along without cutting; and in this position we can apply the sledge hammer with success. But however careful our men were in using the chisel bar, it was no uncommon thing to have some part of a retort broken at one stage or another. I consider it is best to charge each retort, as it is finished, with splint coal, and allow the heats to come up and the cracks to get filled in.

I should have preferred to clean our retorts every four or five weeks, taking one oven each week, when the carbon deposit was about 3 inches thick; but it was often impossible to do this, as our holder accommodation is inadequate, and we cannot keep an oven standing the requisite time in the winter season. Our cleaning therefore had to stand over for six or seven weeks, when the thickness of the carbon would have increased to about 5 inches. In some sets of retorts, the carbon is very irregular. An oven of four single retorts will have an excess; another will have little or none; while the other three will have about the usual quantity. Again some ovens will deposit carbon more quickly than others; and at times some will work much longer than usual.

It will be understood that the ordinary retort is made with a flat back end, at right angles to the body of retort; and as the carbon is deposited at the back, it is very difficult to get it to free itself. In fact, one would think it had been deposited there never to be taken out. The new form of retort also has its back end at right angles to the body, except where it is a little slanted so as to prevent any coke being left in when drawing.

As will be seen from the diagram, the retort is contracted at the back end, forming a somewhat obtuse angle; consequently the carbon, when it is deposited in the back, has some chance of freeing itself, and its even shape looks as if it was intended to remove any carbon which did accumulate.

Some gas managers, whether by force of habit or otherwise, continue to renew their retorts annually; and with regard to cleaning, I am sure



many cannot, or do not, clean their retorts as often as should be done. If this improved shape were once adopted, much trouble and expense would be saved. It is not only more easily cleaned, but, with anything like good management, the deposit of carbon will not amount to 3 inches in eight weeks. When the coke drawing "clat" is kept at its proper size, it will rub up against the inclined surfaces formed all round the back end of the retort, and keep the loose carbon from accumulating to the usual extent, as it is partially cleaned every time the coke is drawn. The cleaning of retorts, also, will no longer remain a troublesome and costly operation, as it will only be necessary to expend a tenth part of the time generally required for this operation, as the carbon deposited is less by 50 per cent., and the time occupied reduced to a minimum; and should any portion of the retorts become broken, some other cause than the cleaning chisel-bar will have to be looked for.

## Cyanogen in Gas Making.

The *Gas World* notes that Herr Leybold, Frankfort-on-the-Main, addressed the Bavarian Gas Association on the above subject at its last meeting. He said cyanogen had of recent years become a factor of great importance in the gas works; it was called for in the production of prussic acid, of cyanide of potassium (used in photography and electro-metallurgy), and of prussiate of potash, from which potassium cyanide and Prussian blue are made. From 90,000 to 110,000 pounds of potassium cyanide are made in Germany every year; it is made from yellow prussiate of potash, but this only represents 5 per cent. of the whole prussiate, the other 95 per cent. of which goes to make Prussian blue. The days of heating old shoes and the like scraps with iron and alkali to produce yellow prussiate are over, yet it still endures in England. The leading source now is the nitrogen of coal treated in the gas works; and though the percentage of nitrogen in coal is about 1 to 1½ per cent., and only a part of it is recoverable as cyanogen, the aggregate value of the whole make is enormous. From 20 to 50 per cent. of the nitrogen comes off on dry distillation, the rest remains in the coke. Some goes to the gas, some to the tar, some appears as ammonia; the part which appears as cyanogen is relatively small, being from 1½ to 2 per cent. of the original nitrogen. A large proportion goes on as free nitrogen in the gas. It is much more profitable to collect nitrogen and cyanogen than as ammonia; the same nitrogen which as ammonia is worth 10.8d. is, as yellow prussiate, worth 6s.

If an indifferent gas, such as hydrogen, be led through ammonia solution, so that ammonia gas is carried forward, and if this be led over glowing coke a great part of the whole of the ammonia is broken up into free nitrogen and hydrogen, with some cyanogen in the form of hydrocyanic acid. With very hot coke and slow gas stream, about ½ to ¾ per cent. of the ammonia is converted into cyanogen. The proportion may become much higher, as in cases in which the ammonia in coal gas is to the cyanogen as only 3 to 1. The circumstances in the gas retort appear to be favorable to the conversion of ammonia into cyanogen. Too high a temperature decomposes the cyanogen found. The cyanogen produced may be estimated by passing the gas through a mixture of iron vitriol and caustic soda solutions (= freshly precipitated iron oxide + alkali); sulphide of iron and sodium ferrocyanide are produced, all the cyanogen taking the form of the latter salt after 15 minutes' boiling; the solution can then be precipitated as Prussian blue, and this precipitate decomposed with caustic soda; the clear liquid is then evaporated with sulphuric acid, reduced with zinc, and titrated with permanganate. The cyanogen is absorbed to the extent of 95 per cent. in the first flask, 5 in the second, and none in the third. Without iron oxide any carbonic acid in the gas drives the cyanogen forward. Some of the cyanide of ammonium in the gas takes up sulphur and forms sulphocyanide, which remains on condensation; some of it attacks the iron and forms ferrocyanide of ammonium. Both of these salts are found in the gas liquor. Very little hydrocyanic acid is removed by the scrubber, because carbonic acid keeps it moving on. The cyanide of ammonium plus carbonic acid becomes carbonate of ammonia and hydrocyanic acid, which last goes on with the gas to the purifier. Cyanide of ammonium is the thing in coal gas; sulphocyanide

and ferrocyanide are formed in the liquor and in the purifier. Cooling removes 8 per cent. of the cyanogen from the gas; scrubbing removes 6½; purification removes 56.15; 19½ per cent. remained in the gasholder gas; unaccounted for, 9¾ per cent. In another case 71 per cent. was recovered from the purifier. Cooling and scrubbing in these cases had left very little ammonia and sulphureted hydrogen in the gas. The more numerous the purifiers the more cyanogen is recovered; and both regenerated and unregenerated used material will absorb it. To work up a high percentage in Prussian blue the first (iron oxide) purifier should be allowed to remain even after it fails to take up any more sulphureted hydrogen. By this means the percentage of Prussian blue can be worked up to 8 or 10 per cent. The velocity of onflow is important; rapidity within limits favors the absorption. The rules are: Big purifiers; a good speed, not too fast; at least three or four chambers; and one chamber allowed to stand a long while specially for cyanogen. Hydrocyanic acid led direct into purifying material is not absorbed; if any of it be dissolved by moisture it is re-evaporated; but if the stuff be saturated with sulphureted hydrogen, so that sulphide of iron is formed, then if hydrocyanic acid be led in, not *too fast*, it will be largely absorbed, even though the mass has been freshly regenerated. Cyanide of iron is formed, and air transforms this into ferrocyanide of iron or Prussian blue—not quite pure however; the product is a mixture of various ferrocyanides of iron, some containing ammonia, especially when the percentage is high. A little sulphocyanide is also formed by a secondary reaction with the sulphureted hydrogen expelled, but it is only a trace. If, however, there be ammonia in the gas, a large proportion of sulphocyanide may be formed at the expense of the Prussian blue; and the Prussian blue is the thing which the purchaser will pay for, not the sulphocyanides. Even though it be neutralized with an acid, the presence of ammonia ruins the Prussian blue by forming sulphocyanide, though not to the same extent as when it is free. Other alkalies act similarly, but also produce, *e.g*, NaCy and $FeNa_2Cy_6$, both of which are objectionable; the reaction must, for the best results, be neutral, and the scrubbing must be of the best. Herr Leybold gives an instance in which good scrubbing was made to replace defective; a third more ammonia was recovered; the Prussian blue and sulphocyanide, instead of 3 and 5.96 per cent. respectively, became 5.64 and 2.92; and the value of the truckload of spent purifying material was thereby raised by £5 16s., even at a low figure for Prussian blue.

So much for the recovery of cyanogen by the dry way; but there is a great future for recovery by the wet way. Make the gas (Knublauch's patent), before going into the purifier, go through a mixture of caustic soda and iron vitriol solutions: the iron precipitate is gradually dissolved with formation of sodium ferrocyanide, which last remains in solution. The carbonic acid and sulphureted hydrogen practically pass on to the purifiers. The cyanogen coming towards the purifiers from the scrubbers is, commercially, wholly recovered (instead of, say, 83 per cent. of it), and the product is in a very workable from, in which it fetches a higher price than in spent oxide; and it is easily concentrated and carried in cistern wagons.

In reply to questions Herr Leybold said the spent oxide ought not to be watered, but might be regenerated if burning did not ensue. Regeneration dried the mass and raised the percentage and value.

The Association resolved to have a formal discussion of the whole question at its next meeting.

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[Continued from Page 295.]

## Notes on Gas Lighting and Gas Fitting.

By Mr. William Paul Gerhard, C. E.

[Reprinted from *Building*, which obtained permission from the author for its publication.]

Regarding the careful proving of gas piping in buildings in course of erection, as well as in buildings already completed and occupied, I cannot do better than quote the following clear description given in the *Sanitary Engineer and Building Record*, Vol. XI, May 14, 1885:

"If the house is in progress of construction, see that all the outlets are carefully closed with caps, and that the foot of the rising line is stopped. Then at any convenient side-light attach the ordinary gas fitters' pump, which is simply an air pump. To the same side-light, or an adjacent one, attach the mercury-column gauge used by gas fitters with a column from fifteen to twenty inches in length. Great care must be now taken to prove that there are no leaks in the gauge or its connections or cock, and in the pump and hose connection, and a good cock should be used between the permanent gas pipe and any temporary connections to pump, so that it may be closed immediately after the pumping stops, to prevent back-leakage of air through the pump valves or hose joints.

"When all is complete, pump the pipe system in the house full of air until the mercury rises at least twelve inches. Then close the intermediate cock before mentioned, and should the mercury column be found to 'stand' for five minutes, it is reasonable to assume that the pipes are sufficiently air and gas tight for any pressure they can afterwards be subjected to. But as it is the rule in the most carefully done gas pipe work to find the mercury will not 'stand,' as there will be leaks that would escape the most careful workman, it is necessary then to locate them.

"Should there prove to be a very large leak, it will be apparent at once, as it will be impossible to get a pressure worth considering, the mercury simply bobbing up and down in the tube.

"It may be an outlet that has been neglected to be closed, or it may be a long split in the pipe. If the former, and very close to the pump, the mercury will not respond; but should it be far away, with considerable length of pipe to cause resistance, the mercury will jump and return as suddenly. But should there be a split pipe or an aggregation of small leaks, the mercury will run back steadily, though slower than its rises, between the strokes of the pump. Should it rise well in the glass and sink at the rate of about one inch in five seconds, small leaks only in fittings or joints may then be anticipated. Of course, there are exceptions to these rules, which are only for general guidance.

"To locate a leak, then, that cannot be heard blowing, strong soap water applied with a brush or sponge may be used. The liquid is rubbed over suspected joints or fittings and air-bubbles are blown by the escaping air.

"Sometimes it becomes necessary to use ether in the pipes in locating leaks, if the pipes are under floors or in partitions. The ether is put into a bend of the hose or into a cup attached to the pipe and blown into the pipes with the air. By following the lines of the pipes the approximate position of a leak may then be determined by the odor of escaping ether.

"In very large work it is well to prove a floor at a time, and when all are done, connect them with the riser and prove as a whole.

"The best thing for making pipes tight for coal gas is gas fitters' cement, which is a common grade of sealing-wax. The threads of the pipes should be immersed in it when warm and let drain, and the fittings also are sometimes so treated. To put the pipes and fittings together both are warmed and screwed tightly and allowed to cool. Porous places incidental to malleable iron or shrinkage cracks in malleable iron fittings are generally stopped with this cement, but a split or crack should never be so mended, as it will be an element of danger.

"For naphtha gases some of the heavy body asphaltum varnishes are considered best, such as black air-drying japan, or black baking japan, but paraffine varnish should not be used. To use the japans both threads of pipes and fittings should be dipped in them and drained, and the japan should be applied with a brush when putting them together, the same as using lead. Red and white lead are also good, but are with more difficulty made air tight.

"If the house is an old one, or has been finished, and you have to test for leaks, take off the meter and cap the bottom of the riser; also unhang the gas fixtures and remove the brackets, and cap all outlets carefully. Then use ether and locate leaks before tearing up floors or breaking plaster.

"The mercury should be made to stand—remain stationary in the glass—if possible, before the work is passed, but a fall of one inch of mercury in an hour indicates a comparatively tight job.

"Occasionally, when a gas fitter cannot get a job tight, there is a possibility he may cut off the part or floor of the building he cannot get sufficiently tight to suit the inspector's idea of perfection. The inspector can only prove such practice by removing or slacking off a cap here or there about the house if he suspects such an attempt. If no air escapes, then he has the dead end."

Mr. William Eassie, the well-known English sanitary expert, writes on this subject in his "Sanitary Arrangements of Dwellings" as follows:

"In England, as a rule, we are culpably careless about our gas supply. A gas company, for instance, receives notice that the service of such and such a house is ready to be connected with their main, and when they have obtained a signed agreement setting forth who is responsible for payment, the meter is connected forthwith, and there is an end of it. The gas fitter may have done many things badly, and not done some things at all, but the gas company seldom, very rarely ever, exercises any jurisdiction. The gas fitter next sends in his account, which

is paid, and when the smell of escaped gas from some faulty portion of the pipes has become unbearable, he is sent for to remedy it, and charges for the rectification. The workman may be thoroughly incompetent, as gas fitting is not, as it should be, a separate trade. Indeed, the artisan who performed the work may be a blacksmith, whitesmith, glazier, brazier, plumber, bellhanger and gas fitter all rolled into one.

"A gas fitter *who is a gas fitter*, and who understands his business, will never take leave of a house until he has tested the pipes for leakage. Where this trouble is taken, the ordinary practice among us is as follows: When the pipes have been laid throughout the house, and the company's main connected to the meter, a temporary burner is fixed to each floor of the house, and the gas is turned on. The gas is now ignited at these trial jets and allowed to burn for some little time. The main is then turned off, and at the same time the exact reading of the index is taken. When the gas left in the pipes has burnt out, the taps of the experimental lights are turned off, and if, after the lapse of an hour or so, the dial of the meter continues to indicate a consumption of gas, it is plain that it somewhere escapes, and the leak is searched for by the sense of smell, etc., and remedied."

The same writer describes his own practice of testing gas pipes as follows:

"Before the gas fitter asks the gas company to make the connection with their main, he sets about proving the pipes. He stops up, with one exception, all the outlets which have been left for brackets and pendants with plugs or with screwed caps. On the one not so stopped he attaches a force pump, into the interior of which has been put a few drops of sulphuric ether. This pump is now connected with a gauge, and it is then set to work, generally until a high pressure is registered. A high pressure in a gas pipe at first appears unnecessary, but gas fitters know very well that iron pipes have many latent weaknesses, so to speak—seams just ready to open, pinholes filled with grease, etc., which might not drop out for years, and a good pressure exerted would rip up the one and cause the others to fall out. When the gauge indicates a certain figure, therefore, the pumping ceases, and if the mercury falls, it is evident that there is one or more palpable leaks, which are at once sought for. The escaped ether will guide the fitter to these, and the defaulting pipes are replaced by others. The pumping is now continued, and the same routine recommences. If the mercury still descends and it cannot be detected, even by the sense of smell, the joints are separately lathered over with soap, whereupon the weak places will be indicated by bubbles. These parts are then marked, heated by means of a portable spirit lamp, made for the purpose, and covered over with an approved and durable cement. When the inspector arrives, the pump is once more in action, and as the pipes are now tight, he has simply to cast an eye upon the gauge, the column of which no longer shows sings of sinking; examine, as before mentioned, how the pipes have been laid, and sign the requisite order."

We must now consider more in detail the injurious effects of gas leaks in dwellings. Leakage of gas may be caused either by defective gas piping, or by worn-out burners, or by badly jointed fixture connections, or, finally, by imperfect, loose or worn stops or keys of gas fixtures. The first cause has been discussed in detail heretofore, and of the latter causes and the best way to avoid them we shall speak more fully hereafter. Escape of coal gas into houses also takes place from broken or defective gas mains in the streets, particularly in winter time, when the road surface is frozen hard, and when, owing to the heating of houses, these act like chimneys, as it were, drawing gases from the soil upwards into the living rooms. Many cases of poisoning by coal gas and not a few cases of gas explosions due to this cause are on record; but we must dismiss the subject with these few words, as we have reference here only to gas leaks existing inside of a building owing to one or the other of the above mentioned defects.

All gas leakages must be looked upon as harmful from three different points of view. First, as regards the pocketbook of the consumer, for all gas escaping unburnt through leakages is registered at the gas meter. Hence arise frequent complaints of exorbitant gas bills, and the general and often unjustified distrust of householders against the meter.

Fortunately, larger leaks, especially at the gas fixtures, are soon announced and easily detected, owing to the well-known pungent odor of the escaping gas. Not so, however, with small, hidden leaks, which may go on unperceived, often for years, being comparatively odorless, and causing not only a useless increase of gas bills, but what is much more important, a steady and injurious contamination of the air of rooms. We must, therefore, regard gas leaks, second, in their injurious effects on the health of human beings.

It should be remembered that carbonic oxide forms one of the components of illuminating gas. This gas is well known to be a deadly poison, causing asphyxia and death if inhaled in large quantities, while if present in the air we breathe in smaller volume, it is the cause of headache, nausea and giddiness, and will in course of time show its steady and injurious influence upon those members of the household who live the greater part of their lives indoors. In coal gas the percentage of carbonic oxide averages 7 to 8 per cent., while in water gas the proportion is much higher, being in the average about 25 per cent. This explains the greater danger incident to the more recently introduced water gas.

Long ago, Mr. Wm. Eassie, the well-known English sanitary engineer, stated that if it were a rule in all towns to have the gas fitters carry a certificate of competency, much sickness, according to many eminent physicians, would be prevented. Dr. B.W. Richardson, a well-known English sanitarian and authority, called attention to this matter by stating that wherever carbonic oxide becomes diffused in small quantities, either through leaky pipes or defective burners and gas fixtures, into the air of badly-ventilated rooms or workshops, it becomes a common cause of nervous derangement and dyspepsia.

More recently, Prof. W. H. Corfield, at a meeting of the London Society of Medical Officers of Health, read a very interesting paper entitled, "Outbreaks of sore throats caused by slight escapes of coal gas," an abstract of which is given in the May 16, 1887, issue of the London *Sanitary Record*.

He pointed out, first, that in considering the deleterious effects of escapes of coal gas into dwelling rooms, attention has hitherto been almost entirely directed to cases of poisoning by asphyxia, due to the carbonic oxide contained in the coal gas. Prof. Corfield next stated that during the past few years his attention had been gradually arrested by cases of illness, and more especially of relaxed and even of ulcerated sore throats, occurring in persons sleeping in rooms in which there were defective gas burners or pipes, but living in houses of which the sanitary condition was otherwise as perfect as the application of modern sanitary knowledge could make them. That the slight escapes of coal gas were the cause of the sore throats was proven by the fact that the persons attacked became quite well on the defects in the gas burners or pipes being remedied. He, therefore, had no doubts that the cause of the sore throats was the breathing for weeks or months, especially at night, of air contaminated with a small proportion of coal gas, and believed that the effective agents in producing the irritation in the throat were the bisulphide of carbon and other sulphur compounds contained in the gas. He was convinced that in numerous instances these ulcerated throats were thought to be due to foul air from drains, when they were really due to escapes from gas pipes or gas fixtures.

In the discussion which followed the reading of this paper, Mr. Rogers Field, M. Inst. C.E. referred to numerous cases in his practice as sanitary engineer, where offensive smells attributed to defective drainage, were found to be due to escapes of gas. He, therefore, made it a practice always to have the gas pipes tested, and made thoroughly sound after the drainage of a house had been reconstructed. He found the only effectual method of testing the gas pipes and fittings to be to attach a pressure gauge and then pump air into the pipes. If the gauge stood, the pipes were sound; if it fell, there was a leakage which had to be found out and remedied, and the work was not left as completed until the pressure gauge would stand.

The writer could quote several instances from his own practice where plumbing work thought to be defective was found, after careful inspection, to be tight and in good condition, whereas the bad odors complained of were traced to leakage from furnace smoke flues, or to leakage of illuminating gas. It is somewhat unfortunate that of late years it has become customary to raise the cry of "sewer gas" whenever any contamination of the house air is noticed. While it is true that defective plumbing work is, in many instances, without doubt, the cause of bad odors in houses, the contamination of the air and noxious smells are also not infrequently traceable directly to other sources, such as leaks in the joints of furnaces, or leaks in brick smoke flues, or, finally, leaks in the gas piping, or at the gas burners and fixtures.

Thirdly, gas leaks become objectionable owing to the accompanying danger of an explosion. When illuminating gas escapes unburnt from a gas burner, or from a leaky pipe joint or defective fitting, it mixes with the air in the room, and when this mixture reaches a certain proportion it becomes explodible. Hence the rule should always be observed when an escape of gas is noticed never to search for the leak with a light. A gas meter has often slight leaks at the couplings, and therefore a meter should never be examined except in daylight. It is astounding how often in everyday life these plain rules are violated even by intelligent mechanics. Gas explosions often occur with very fatal results to life and property. Many fires owe their origin to such acci-

dents, and the greatest care should, therefore, be observed to prevent them by avoiding all leakages.

Much ignorance prevails among the public as well as among builders as to certain precautions which must be observed to render gas lighting safe from the point of view of fire. A few hints regarding prevention of fires from this cause may not seem out of place here.

First, the house owner or householder should ascertain that the system of gas piping is perfectly sound and tight, and kept as much as possible accessible for occasional inspections; also that the burners and fixtures do not leak.

## Classification of Incandescent Lamps.

At the Cape May meeting of the National Electric Light Association, an interesting discussion was had on the subject of the proper classification of the lighting power of incandescent lamps. For our report of same we are indebted to the *Western Electrician*. Dr. Louis Bell, of New York, the first speaker, said:

"I have raised this question for the consideration of the National Electric Light Association because it seemed to me a very curious thing that the whole subject of the classification of electric lights has not been more thoroughly gone into at previous meetings, and that there is now no general accord, either in the classification of incandescent lamps as regards their light-giving power, or the methods in which that light-giving power shall be measured. It is rather a singular thing that light should be one of the most difficult things to measure absolutely that we have—not difficult to measure relatively, except in certain cases with which we are unfortunately only too familiar; but it is exceedingly hard to find anything like an absolute standard of light. The last desperate effort of the convention in that direction only resulted in perhaps as impracticable a standard as was ever brought before the consideration of a scientific body. The question of classifying electric lamps is coming to be rather an interesting one, and one that is of importance to those who supply the lamps. We have various sizes and sorts of incandescent lamps, of all sorts of nominal incandescent candle powers, the most usual in this country being the 16-candle power lamps; but is there any common accord as to what is meant by a 16-candle power lamp? I think not. And when the matter comes to be tested we find that it is not so. Of the various lamps which are now in use rated at 16-candle power nominally, some of them give the full candle power called for by their names; others give 10, 12, 14 or 15; and some of them give more than the rated candle power, while others give more or less than 16-candle power, according to the method of measuring which is used. We do not know at first sight whether it is fair to say that a lamp is 16-candle power when its mean horizontal intensity reaches that figure, or when its spherical intensity reaches that figure, or when its hemi-spherical intensity reaches that figure. That whole question is open, and certainly ought to come under consideration by this body. Then again, suppose we take one of those particular candle powers to be the standard; for instance, suppose that we take the horizontal candle power, which is, perhaps, the easiest to measure. Are we then in any better position? It might seem so at first, but a moment's consideration will show that the size, or rather the shape of the carbon filament has a very important bearing on the distribution of the light, and that consequently a light which gives in any one direction 16-candle power may give considerably less in any other direction. Again, if we attempt to fix a standard direction, as, for instance, a direction normal to the plane of the filament for measuring the candle power, we again get into trouble, for the reason that while the filament of a circular section gives a nearly equal distribution of light, a rectangular filament necessarily, theoretically and practically, gives an unequal distribution, the maximum intensity being at 45 degrees off of the plane of the filament, or thereabouts. So that looking at it in any way we like we find that when we are speaking of a 16-candle power lamp we may or may not mean the same thing. With the arc lamp we unfortunately know that the case is even worse, for instead of having an approximately equal intensity throughout a reasonable range around the lamp, we have a maximum intensity in a zone perhaps 20 degrees wide and deflected 45 degrees below the horizontal plane of the arc. Furthermore, we know only too well that the nominal candle powers of arc lamps are quite different from the real. The whole subject is in a tangle which at first seems almost hopeless. Heretofore it has not been specially important in the early stages of electric lighting, because people did not look so closely then into the exact conditions under which the light which they purchased shall be given; but as the electric lighting business comes more and more down to close competition and hard commercial lines it becomes more and more necessary to look after these things, and to define just what we mean by the lights which we contract to furnish, and to arrange some way by which there shall be general consent as to the meaning of the terms which we use. I am happy to say that, as most of you know, the practice abroad tends toward something quite different from the candle power measurement; it tends toward the selling of electric energy by watts, even when it is furnished as light—the kilo-watt hour being the British Board of Trade unit; and it is a question which I think we should take up, whether it is not perhaps advisable to classify by watts, a quantity which can be measured with the greatest ease, instead of by candle power, a quantity which is only measured with extreme difficulty. I pass over for the time being the difficulties in actual photometric measurement depending upon the difference in color, as they are subsidiary; but the great question seems to be to find some one definite thing which we can all agree to call a lamp of a certain size, whether it be 16-candle power, or 16 watts, or whatever you please to call it. Of course, certain objections to the watt classification instantly arise, and among them is the possibility that it may tend to develop a type of lamp which will not be quite as efficient as those which are now generally used. That, of course, is simply a possibility, but it is one of the things that we want to bear in mind, for, objectionable as candle power measurement may be, it is not well for us to be blind to the difficulties that come up with any other form of measurement.

I desire to bring this subject prominently before the National Electric Light Association, because it is one in which I have felt a great deal of interest, and which I have had occasion to study somewhat, although perhaps more from the scientific side, in the matter of photometry. I believe it is a subject which calls for action on the part of the Association as a body, because I think the time is coming, and is in fact now here, when some such definite standard of measurement is needed and should be had; and this is the only body that has the power to make and to enforce any classification of light which may seem desirable after a consideration of the whole subject. I think that it is a case for action by the Association, and that it should take measures that shall lift us out of the very puzzling difficulty into which we have fallen simply through negligence, and through no fault or intent to deceive, but simply because the whole matter has been allowed to slide, and everybody has gone on in his own particular way instead of having, as we must soon have, something definite, something exact, something perhaps not scientific, but something which shall be at least empirically definite.

Mr. Garratt—It must be a matter of pleasure to all of us to have this subject brought before this convention. There certainly is no one thing which has caused so much aggravation to the soul of the average electrician as the effort to find some basis on which you can talk about the candle power of lamps. The trouble with trying to establish in America a practice similar to that of the Board of Trade in London is the fact, which we might as well recognize, that the National Electric Light Association can not enforce anything. Some years ago I made no less than five hundred thousand figures for this Association to enable it to measure wires. I made enough figures to reach from the city of Boston to the city of Providence. But, after having made those figures, and after they had met the approval of a majority of the members, we found that we were totally incapable of making anybody use them.

There is certainly nothing better for the unit of incandescent lamps than the kilo watt hour, provided there is proper precaution taken that the makers be not led to turn out a lamp which may possibly not be as efficient as the customer ought to have. Taking the kilo watt hour as the unit of energy for each lamp, and fixing the length of the life of the lamp, would seem to tie up our friends, the lamp makers, pretty tight with regard to what we should call a 10, a 16 or a 20-candle power lamp. It is quite impossible to make the purchaser of the lamp, the householder, ever talk about kilo watt hours. They will purchase what they know as a candle power lamp. But this Association might very properly suggest to the manufacturers of lamps that a 16-candle power lamp or a 20-candle power lamp should absorb so many watts; and the unit of charge to the customer might be based upon watts as against hours. That might be perhaps best brought before us in proper form by the action of a small committee who could bring the subject before the next meeting of this Association in a paper and if it is satisfactory to the body it might then be recommended to the lamp manufacturers. It is a thing which I do not think the general public will do very much with; and I do not see that it is a thing which the National Association can very well enforce. But I am positive that the kilo watt hour would meet the approval of all the electric light fraternity in the country.

Mr. Alexander—Not many years ago I attended a lecture given by a gentleman on incandescent lamps. He was a very learned man indeed. He told us all about incandescent lamps; and in fact he made one state-

ment—and it is that particular statement that I want to allude to—that in order to give a certain efficiency to a lamp the carbon filament should be of a certain structure, and should be .9188 of a millimetre in thickness. I was talking about it with a gentleman who was very much interested in the subject, and he illustrated several facts with a great many equations, and he had it all printed for the edification of his hearers, and I had it in my hand, and looked at it hopelessly and put it in my pocket. I commenced to say that when he mentioned that the carbon filament should be .9188 of a millimetre in thickness I was reminded of my youthful days, when a man was pointed out to me who was quite a genius; and that gentleman had a grease spot on his coat, and he immediately went to studying chemistry to see by what means he could best get that grease spot out of that coat without injuring the texture of the fabric; and he studied day and night for two years, until he finally got it; but when he got it the coat was all to pieces and he could not wear it. It is not a scientific lamp or a laboratory lamp that you want; it is a commercial lamp for everyday use. When Dr. Bell brought up this subject (which is certainly a very interesting one) I thought at first, why don't you speak about the candle power efficiency of the arc lamp? There is certainly much more variation between the so-called 2,000-candle power of the arc lamp and its actual power than there is of the incandescent. I recollect a measurement made three or four years ago by which it appeared that a 2,000 candle power arc lamp varied from 134 to 1,386 candles, according to the measurements made then; but still they were all called 2,000-candle power lamps.

I want to ask why you do not measure your arc lamps by watts, and why you measure your incandescent lamps by watts. The efficiency of the lamp to the consumer is of the greatest value only in some cases. If I have a water power to run my central station, as the power does not cost much of anything, I do not want an efficient lamp, but I want a long-lived lamp; but when I use coal at $5 per ton I want a very efficient lamp. It is a fact that I have had from one railroad company a letter in which they asked me for a very efficient lamp, because it costs them more to move their storage battery in and out of the car than the breakage of the lamps amount to. They have by figures furnished by their electrician shown that a very short-lived lamp—say a lamp that lasts them but 100 hours—is cheaper than one which lasts them 600 hours but needs a great deal of current. In measuring lamps Dr. Bell has no idea but that we can measure a lamp very carefully and nicely, and then put it in as an actual 16-candle power lamp; but when he will consider that in manufacturing, three little girls, who are paid from $4 to $7.50 per week, have to measure from 2,000 to 2,500 lamps on a photometer per day, he will see that a commercial lamp has to be made at a price that the central station would not want to pay if every lamp was figured right down to the $\frac{1}{100}$ or $\frac{1}{10}$ of a candle power. It is impossible to do it. In the lamp with the twisted filament, as you know, the light can be measured upright, and you get an equal diffusion of light; while in another lamp you would have to make, of course, two measurements, and the mean measurement of those two ought to be sufficient and come near enough to the actual measurement of the other lamp with the twisted filament to offset any commercial distinction.

Dr. Bell—I am not speaking of the laboratory lamp at all. I am speaking of the practical commercial lamp with which we are to deal. I am not asking Mr. Alexander nor anyone else to make a lamp which shall have exactly 100-candle power; I only wish to have our incandescent lamps certainly classified within 25 per cent. of their proper value. We do not have to see far to find lamps put out on the market as 16-candle lamps which do not give efficiently 13-candle power. That is the kind of inefficiency I am talking about, and not about any question of measuring the hundredths of candle power. What do we care about hundredths of candle power, or what do we care about a difference of one half a candle power in different directions? If the difference rises, as it sometimes does, to be 4 or 5-candle power in different directions, then it is something that we ought to take cognizance of. I am not speaking of laboratory tests or of laboratory lamps; I am speaking only of practical commercial incandescent lamps. The question of arc lamps I felt tempted not to touch upon for the reason that we have not been in the habit of measuring those anywhere in the world by the watt. The incandescent lamp is supplied frequently by meter, and that is what brings the matter of classification into special importance. We all know very well that the arc lamp is a great sinner in the matter of the distribution of light, and in the difference between theoretical and practical efficiency; but at the same time we ordinarily do not measure the power supplied to arc lamps in watts, as is getting to be somewhat the custom as to incandescent lamps. I should certainly be in favor of including the arc lamp in any action which the Association might take on this question. I am not here to malign the incandescent lamp. I think it is a matter of wonder that the incandescent lamp is as generally efficient and successful as it is; but I think the time is coming when we ought to come to some definite conclusion as to what we mean when we say that a lamp is a 16-candle power lamp, and sell it for such, knowing as I do that the lamps now in the market known as 16-candle power, vary rather more largely than even the conditions of commercial service make desirable.

Mr. Alexander—May I just say that I consider that when a lamp is sold as a 16-candle power light and gives but 13 candles, it is a dishonest thing; as to the other question, about selling efficient lamps, that is your business. I saw in New York city the other day bills which were made out by watts, which I considered a very proper thing to do.

The President—I was in conference with a young man representing a lamp concern, and the question came up as to the price and efficiency of lamps, and he said: "It is altogether a question for us whether you sell by meter or by contract. If you are going to sell by meter, and your customer pays for the lamp, we will give you an inefficient lamp, so that the bill will pile right up on him; but if you are going to sell by contract we will give you a very much more efficient lamp, and you can furnish a lamp that will be much more efficient and you can make the same money." That shows that the young man who represented the lamp understood how to meet the demands of business.

In making a test of the lamps of six different makers I found that the variation in 16 candle power incandescent lamps is much more extreme than would be called a fair ordinary commercial average. I found that in two lamps the variation was from 17.25 candles to as low as 6.42 candles; and the watts per candle varied from 3.13 to 8.2 watts per candle.

Mr. Garratt—Were those all new lamps?

The President—They were.

Mr. Alexander—That is a subject that I am interested in; and I want to say that a lamp that will measure at the start 12 or 13-candle power, after 200 hours will likely give more light than a lamp which measures 17-candle power at the start. All these matters have to be considered. If I desired to make an actual test I would measure the lamp after 15 hours' burning, and then I would get a good result.

The President—We are now going through with tests and measuring every 25 hours. I will say, however, that a lamp which gives 17.25 candles was the lamp which at the end of 1,000 hours showed the least blackening of any lamp we had, but unfortunately it was not as efficient a lamp as I would like to have.

Mr. Coggeshell—Were those lamps tested, by one maker?

The President—They were made by six different firms.

Mr. Garratt—I move that the President be instructed to appoint a committee who shall report at the next meeting of the convention on the proper classification of the lighting power of incandescent lamps. [Adopted.]

## A Novel Method of Raising Water from a Shaft.

At a recent meeting of the South Wales Institute of Engineers, Mr. W. Galloway reported that the shaft sunk by the Cardiff Steam Coal Collieries Company (Limited), at Llanbradach, was put down for the purpose of ascertaining the exact depth of the coal, and to gain such information as to pumping requirements. etc., as would enable the engineers to determine with some degree of certainty the fittings of the future colliery. It is also intended to form the upcast when the winding shaft has been sunk. It was known that a considerable thickness of the Pennant sandstone series, which is invariably found heavily watered, required to be passed through, and surrounding collieries have heavy pumping fittings. The absence of any means of determining the probable quantity of water to be dealt with in sinking led to special provision for winding the water to the surface. The contract provided for certain allowances whenever the water exceeded 4,000 gallons per hour, whether pumps were provided or not. The largest quantity met with was 7,500 gallons an hour in the shaft bottom. Down to a depth of 135 yards the total growth was 9,000 gallons an hour, of which 5,000 gallons was walled out by brick and cement walling.

It would have been impossible to proceed with the sinking without pumps had it been necessary to fill the water into the kettle by the ordinary means of bailing. This bailing the author says he has long regarded as a disgrace to the art of mining, and so he devised what he calls the "Pneumatic Water Barrel." It consists of a cylindrical vessel of sheet iron, 4 feet 2 inches in diameter, and 8 feet deep, closed at the top by an air-tight man-hole door. The bottom is 5 inches above the lower edge of the cylinder, and has a circular hole in it 18 inches in diameter. This hole is closed by a faced valve of cast iron, mounted with

a sheet of leather, capped and tightly clasped by an iron hoop. The valve is attached to a spindle by a ball and socket joint, by which it is kept in position, but allowed a certain amount of play so that it may readily accommodate itself to its seat. The cylinder is thus an air-tight vessel, the interior of which has communication with the exterior atmosphere only by means of a pipe extending from close to the top of the cylinder in the inside, to the outside of the vessel half-way down. The outside end of the pipe is fitted with an instantaneous coupling identical with that used on the vacuum railway brake.

In use the pneumatic water barrel is lowered into the shaft till its lower edge is under water in the shaft bottom. The interior is put into communication with a condenser air pump on the surface by attaching a flexible tube, connected to the vacuum pipes in the shaft, to the instantaneous coupling of the barrel. A vacuum equivalent to 20 to 22 inches of mercury is thus obtained inside the barrel, and the water rushes in through the bottom valve. A glass gauge tube on the outside of the vessel shows when it is full. The tube is detached, and the signal given to raise the barrel. When it reaches the surface a bogie is run under it, and it is lowered on a conical block of wood, which raises the valve, and the water escapes. With 7,500 gallons of water an hour thus raised, the rate of sinking was four yards a week. When the growth was only 500 gallons an hour, the progress attained was 6½ yards per week.

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[A lecture delivered by Prof. Elihu Thomson before the American Institute of Electrical Engineers.]

## Phenomena of Alternating Current Induction.

Mr. President, Ladies and Gentlemen, and Members of the Institute: The subject which we have in hand this evening is more of an experimental character than otherwise, and the object is to bring before the Institute chiefly the results of some actions in relation to alternating currents—actions which are novel and curious, and some of which have never before been shown to the public. Others formed the feature of the exhibit which we made at Paris in the past year. The lecture will deal chiefly with effects producible in closed conductors or closed bands subject to the influence of what we call induction. Every one is familiar with the action produced by passing a current around a bar of iron. If we have a coil surrounding the bar and pass an ordinary continuous current, as it is termed—a current which does not change its direction and does not vary greatly—we get, according to the direction of the current, north and south polarity respectively developed at the ends of the bar and down the sides to some extent, the neutral region or point of no polarity being in a bar of uniform section and of uniform material about the center. I may say that the magnetization in putting the current through the coil is almost instantaneous ; that is to say, if the magnet is of moderate dimensions and we connect it with a battery, we find at once that the ends are north and south in polarity. But if we take such a magnet and surround it with a thick copper tube, or, what will answer just as well, a band of copper, which makes what we call a closed circuit, then we find that on passing the current into the inner coil, for example, the magnetism does not appear instantaneously at the ends, but we have it coming very lazily and gradually, according to the thickness of this outer envelope of copper. We make what is called a sluggish magnet. We slow up the production of magnetism in the bar. The reason for this is very simple. When we start the current through the inner coil, we have at the same moment a reverse or opposing current passing in the outer coil or band which kills or holds back the development of magnetism. After a little while, it may be a second or two in moderate sized magnets, sometimes even more than that, the magnetism has reached about its normal value as though no band or closed circuit surrounded it. We can in this way construct magnets which will not respond to quick impulses of current, but will only respond to impulses lasting for a certain time. These are facts which are pretty well known and sometimes made use of. But let us now consider what would happen if we were to take away the continuous current and substitute what we call an alternating current—a current which goes in one direction during a portion of the time and reverses, going in the other direction, during another portion of the time. These currents can be made to change their direction many thousand times a second, or we can have them change only a few times a second, or have them change every few seconds. The period or rapidity of vibration or alteration can be varied within the widest limits. We find that with the alternating current passed through the coil—removing the envelope—we will get north and south polarity quickly reversed. That is, every time one current moves one way through the coil, north magnetism will appear at one end of the bar and south magnetism at the other, and when it reverses, the magnetism will reverse, and if the current alternates or changes its direction many times a second, these alternations of magnetism will produce what we call an alternating magnetic field outside of the bar. At the same time we will notice that the alternating current is strongly opposed in its passage by having to reverse the magnetism. That is, it is doing the work of upsetting or turning around the particles of iron in the bar and it encounters an opposition. The poles will reverse rapidly, as I was saying, and we will have magnetism developed, but we will not be able to tell whether it is north or south if the alternating current is changing its course rapidly ; but we will find, as I have said, that the alternating current will not pass as freely through the coil as a continuous current, but will meet with an opposition which we call self-induction, or counter electromotive force. Now, if we put the closed band in place around the coil, we will find that the magnetic effects are almost wiped out, and further, that the opposition to the passage of the currents through the coil has been almost exterminated. Or, in other words, the coil has now become transparent to the alternations—the alternations passing freely through—whereas before they were very much hindered. Here, then, we have another difference from the action which takes place with continuous currents. Furthermore, we find that if this band is loose or movable we will get mechanical actions exerted with the band in certain positions. We make use of these principles in what are called reactive coils for alternating currents, an example of which is found here. (Fig. 1.) If we pass through the coil which you see wound upon this structure or core made of sheet iron, if we pass a current through this coil, we find that when this copper piece which forms a band around the coil is over here away from the coil, a very great opposition is exerted to the passage of the alternating current, and we can use that coil in order to oppose the passage of such currents just as we would put a resistance in circuit with a continuous current to oppose its passage, with this difference, that wherever we use a resistance in circuit with a continuous current, we lose the energy of the current, we waste current ; but in the case of the use of such a coil as this—a self-inductive coil—we waste only a small amount of the energy and are enabled to oppose the passage of the alternating current or currents with great force—cut it down without making the loss real.

If now we wish to remove that opposing influence we can do it with the greatest possible smoothness by simply bringing this closed copper band over the coil, and we can graduate in that way to the nicest degree possible the force of the alternating current subject to this action. But we would notice, in using the apparatus for the purpose mentioned, that, when we began to bring this copper over the other coil, an opposition to the movement—we would find a repulsion—a tendency to drive back or remove the copper. In fact we can easily imagine that with the copper band in the present position a strong current sent through the terminals of the apparatus would throw it completely over so as to put the full kick or reaction in the circuit. This repulsive action is one of the phenomena to which I wish to call attention particularly this evening. That is, we propose to make this outer band loose—to give it a chance to move and then study some of the actions obtained. I brought to the notice of the Institute about three years ago a variety of dispositions of parts, apparatus and devices showing this repulsive action, and I explained it, but we had not then the opportunity for actually bringing to the notice of the members the instances of the experimental action of the devices—the devices were not at hand, the current was not at hand, and it was not easy to arrange matters. But we will now make up for that, or try to. Now it is hardly worth while this evening to go into a full discussion of the causes of this repulsion. I will state it very briefly, and it will be a repetition of what has already been said before the Institute. It is simply this—the cause of the repulsion is that in this outer band there will be developed during the passage of the alternating impulses through the inner or inducing coil, currents which are opposite in direction thoughout the major part of their time of existence to those which produce them. If we could imagine a current passed through this inner coil producing what may be called the theoretical effect purely, there would be no such repulsion. But there comes into play an action which we will call the lag or retardation of the impulse. This action disturbs the opposition of the waves in such a manner as to cause the current produced in the outer band by induction to be opposite in direction to the currents which produce the induction ; and opposite currents according to the laws well known, are repellent : so that if we have two conductors near together, in which opposite currents are flowing, we have a repulsive effort exerted. We ought to get, according to theoretical considerations, and without introducing any consideration of displacement of currents from the theoretical position—a wave which is just a quarter of the wave length back of the wave which induces it. But in actual practice, if we use as the close band a conductor of considerable size, and of good conducting material, this wave is not so produced ;

but it is moved. it is shifted to this position (illustrating); that is, our real wave is not the one the quarter wave displaced, but we find it nearly where I now show it. That is, the current on one coil is in one direction, the current in the other coil is in the opposite direction, and this produces a repulsive effort. I do not propose to go much further into the consideration of that subject, because we have a number of phenomena to bring before you and that matter has already been discussed before the Institute.

One of the earliest experiments which I happened to make as showing somewhat similar action to that just mentioned, was to take a coil of wire provided with an iron core, and support a disc of copper, in a balanced way, in front of it, keeping it properly balanced by counterpoises. We will carefully adjust the weight so as to get it to about a balanced condition. On passing a continuous current through this coil, we simply

FIG. 1.

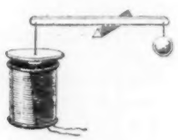

FIG. 2.

magnetise the iron inside the coil. We produce suddenly a north pole at this point, but that sudden production of a north pole induces currents in the disc placed opposite to the pole which flow in such directions as to produce a north pole, as it were, pointing downward, so that these two north poles repel each other. If, on the other hand, the disc were slightly lifted, and I cut off the current, the disc will at once fall; but if I repeat the operation of putting on the current and taking it off quickly, we find that there is a continued repulsion; or, in other words, the disc is kept at a distance from the core. The disc now is down and I will put on the current and you will see it rises about ½ in. and is now in oscillation. I tried this experiment about five years ago. You see that every time I put on the current there is a repulsion upward of the disc. If now I quickly make and break the circuit you will see that the disc will stand at a distance. It is thrown off the core. We have, in other words, a repulsion produced by continuous currents quickly interrupted. That is due to the fact that the currents induced or set up by the production of a magnetic pole in this core are attended by the production of other currents in the disc, which oppose the action and drive the disc away. (Fig. 2.)

Alternating currents applied to the same conditions may be regarded as very much more rapidly interrupted, and, at the same time, reversed currents, and consequently the magnetic effects are very decided. To show the action with alternating currents, we have only to take a plain copper ring and lay it over the coil as you see. (Fig. 3.) We have a source of alternating currents which are conducted from the lines, out-

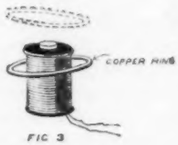


FIG 3

FIG 3A

side, and which are transformed by a transformer to 200 volts, beginning at a thousand volts on the supply lines, and I will close the circuit of the secondary coil, and you see that we have a copper ring resting on a support some distance down the inducing coil. You see this action of repulsion is so considerable as to throw the ring bodily upward. Here the action is exactly what we have before seen, but it is intensified to a wonderful extent. This is a heavy, solid, copper ring, and it is driven, as you see, up into the air quite a height. If I put on the current now for a few moments permanently I may be able with care to balance this ring for an instant in free air. This action of repulsion may be exhibited in very many ways, and as you see we have one here, in which instead on holding the ring it is now supported in the air. But that is not all; two rings are as well supported as one.

The reason for this is quite simple. That ring is affected by the alternating current passing in the inducing coil, and it is affected in such a way as to produce currents that circulate reversely, but are always behind time as respects the inducing currents so as to be in the opposite direction to these currents at nearly all times. This second ring put under the same conditions is affected in precisely the same way as that ring, and therefore the currents in that ring and in this ring are parallel and in the same direction. Consequently they attract each other instead of repelling. We have then repulsion from this first band and the coil, between this second band and the coil, and because the one is affected like the other, we have attraction between them so that they hang together, and you can hear the tremor of the alternations. That little rattle you hear indicates simply the time when there is no current The rings fall apart for a moment, and before they can get apart another current is set up which draws them together. (Fig. 3 A.)

Not only is this repulsive effect manifested as you see, but if the ring

FIG. 4

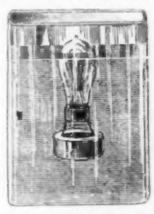

FIG. 5.

cannot get away from the coil it will undergo what we call the deflective action, or it tends to turn up; besides the action is exerted all around the coil, as you see. I cannot bring that ring over the coil. It is thrown back. Wherever there is any of this magnetic field the repulsion is exerted and it tends to turn the ring up into the vertical position or plane. The moment I turn it down in this fashion you see it is with difficulty that I can pass it over the coil. But if we desired to cut off all this effect we would only need to cap that coil with a very heavy copper cap, and then the experiments would take on a very different character. I cannot lay this copper plate on the coil, as you see. This acts just as the ring does. It is a number of rings concentric, all of which can have current developed in them, and it is impossible to lay this plate on the coil, for it is driven away. If I were to cut the current off and lay the ring down, and then put on the current in the inducing coil, the copper disc would jump off. That is the case, too, with a silver coin if we get the field strong enough. There is hardly force enough there; but if we get a very powerful field a silver coin will be thrown completely off. This disc, we may say, exhausts the magnetic field. If I lay it in the field and force it down I get an effect preventing the passage of magnetic force through it. Here is a lamp which I light simply by connecting it with a coil and bringing the coil near this coil or pole. Notice when I put the copper plate between. Now we will insert the copper plate, the lamp is extinguished. And the moment we withdraw the

FIG. 6.

plate it lights again, and we can graduate its intensity, and as it were, turn the lamp up and down as we do with gas. (Fig. 4.) I call this a shading action—that is, the plate shades the magnetic field. Or it may be said to be a deflector; it deflects or reflects the magnetic field. It is like a polished plate of silver as compared with light, and we have only to bring it down to the field, and we find that the field is diverted and kept from passing through, so that it cannot affect the coil on the upper side which would feed the lamp if the field were not shaded. We could vary these experiments to a great extent, and I had prepared a few examples of variation, but one of them met with an accident, that was this little floating lamp. This little lamp ought to be connected with the coil, but it got broken on the way, and therefore I cannot show the experiment. It was to be placed in this glass vessel full of water, and, as you see, it would fall to the bottom. If the circuit had been complete, on putting it into the field we would not only see the lamp light under the water by the sheer effect of the magnetic field traversing the water and producing light in the lamp, but we would also see at the same time the

lamp rise, and we would have both phenomena—the production of current, demonstrating that the action is due to current developed in the coil because the current lights the lamp, and we would also have the repulsive action of the current. It is a very pretty experiment, and I am sorry it has been prevented by this accident.

There is another point, however, I cannot leave out in connection with it, namely, that we might have the coil floating in the liquid at a certain height as repelled, and then by diminishing the current here in the inducing coil, we would find that instead of having the lamp changing its brilliancy it would simply settle down and remain of the same brilliancy as before; that is, the repulsive effort would become less. It would drop to a position where the repulsive effort was as much as before, and then the lamp would have the same brilliancy. We have, as it were, an automatic regulator for the lamp by which, no matter how the current varies, we can have a standard illumination. (Fig. 5.)

But fortunately I have arranged to show this in a different way. I have a lamp and coil which are placed on the end of a lever. This gets rid of the liquid and gives us a means of balancing the lamp at any brilliancy we desire. I there place the little lamp on the lever, put counterpoising weights on the other side, and you see it floats or is balanced at a distance from the coil. But if the inducing current were slightly diminished, we would find that the lamp would settle down. In fact it does always rise and fall a little from the variations on the circuit. I may set that lamp, then, to burn at a certain brilliancy, and if I wish to vary the brilliancy I take off a weight from the counterpoise and it rises in brilliancy. If I add more weight to this side I would, of course, diminish the brilliancy, and it might remain balanced under these still new conditions. I take off several of the counterpoise weights. There we have considerable increased brilliancy given, and the lamp will remain so, no matter whether the current fluctuates or not, providing we always have a space between the coils, which will enable it to go and come and preserve its proper brilliancy. (Fig. 6.)

(To be continued.)

## Something about Quicksands.

Every gas engineer, it is almost safe to say, has, at some period in his working, been puzzled to determine the best way of dealing with quicksands, hence the subject matter of a paper on these "earth waves," presented by Mr. Wilfrid Airy to the British Institution of Civil Engineers, will likely prove of interest. The author explained that articles great and small, which would be perfectly well able to float in water, are unable to do so in a quicksand, although it is of greater specific gravity than water, and are gradually drawn down. Vessels which have been stranded on quicksands by a falling tide have been unable to float off when the tide has again risen, and after being swamped have settled down deeply into the sand; and, in the descriptive accounts of such accidents, it is often stated that there appeared to be something mysterious in the way the vessels disappeared.

When a vessel or other body floats in water, it floats by virtue of the vertical components of the water pressures around it. If, for instance, the body be a rectangular box floating with its sides vertical, then the box floats solely by reason of the water pressure on its bottom; and, if its bottom were protected in any way from the action of the water, the box would not float. This is precisely what happens in the case of a quicksand. The mingled mass of water, silt and sand which constitutes a quicksand forms a semi-fluid which is not capable of transmitting the full hydraulic pressure of the water. When, therefore, a vessel comes upon such a quicksand, her bottom is partially protected from the action of the water, and she is unable for a time to float up, even after the water has risen considerably higher than the ordinary flotation level of the vessel. Sooner or later she will float up if she be not swamped.

A quicksand may be defined as a mass consisting chiefly of sand; but partially also of silt or argillaceous matter so intimately mixed with water that it forms a semi-fluid, having all the properties of a fluid, but in a minor degree. The most familiar instance of a quicksand is that of the sand on a beach, where it is kept alive and mixed up with water, soil and organic matter by the action of land springs rising from below it; this often forms a very dangerous quicksand. But the admixture with water may be due to other causes. In general, the tendency of silty sand is to sink together and form a firm, compact body, having apparently none of the properties of a quicksand; but this very sand, when its surface is disturbed by mechanical violence, such as the force of the waves, will, to a certain depth, become a quicksand. The grains of sand become so intimately mixed up with the water that the mingled mass of sand, silt and water becomes a semi-fluid covering the solid body of the sand to a certain depth.

It will be readily seen that the extent to which a mass of sand is capable of becoming a quicksand will depend upon the fineness of the sand and the extent to which it is mixed with silt or argillaceous matter. If the sand be sharp and clean, no matter whether it be coarse or fine, it has very little of the nature of a quicksand; but if it be in a fine state of division, and be mixed with silt, etc., the particles will be readily held in suspension by the water, and it may form a deep quicksand. If a vessel be left upon such a quicksand by the falling tide it will sink considerably into it, and the sand will form a very complete and sufficient seal round the bottom; and on the subsequent rise of the tide the vessel will not float when the water has reached the ordinary flotation level, but a considerable time will elapse before the water can communicate sufficient of its pressure through the seal of sand to float up the vessel; and in the meantime the water will have risen considerably higher than the ordinary flotation level of the vessel.

In order to verify the conclusions, and to obtain some reliable measurement of the effect of such quicksands, Mr. Airy made experiments in the following manner: A trough was prepared containing several inches in depth of the sand to be experimented upon, with water above it; and the surface of this sand worked up by hand so as to become "quick" to a small depth. A rectangular water-tight box, 12 inches long by 8 inches broad, was then floated in the water, and was forced down upon the sand with its sides vertical, and sunk into it to the depth of ½ inch. When released from the pressure by which it had been forced down, it remained sunk, and was held down by a great force, due mainly to the atmospheric pressure, while at the same time its bottom was protected from the action of the still greater external pressures by the seal of the sand. The time was then observed which elapsed before the external pressures were able to break through the seal of sand sufficiently to float the box.

Many experiments were made with different kinds of sand, both fine and coarse, with the general result that clean and sharp sands had few of the properties of quicksand. But the case was different with sands which, although apparently clean, contained an admixture of clayey matter. When the box was forced down upon such sands it felt quite free as if floating, and could be moved about laterally with great ease; but it offered very great resistance to a vertical pull. The experiments all showed that there exists in fine sand, with a slight admixture of clayey matter, a capacity for becoming "quick," and holding vessels to a degree, which, in combination with other causes, may act powerfully in bringing about some of the terrible and unexplained shipwrecks that so frequently occur on sand banks. If in any case it should be thought advisable to make provision for freeing ships from sand banks which they might be liable to run upon, the plan to be pursued is tolerably clear. All that is wanted is to assist the external water in breaking through the seal of the sand round the bottom, and re-establishing the full hydraulic pressure. This could be done by forcing water with pumps through the holes in the ship's bottom, and would probably soon have the desired effect.

## French Practice in Creosoting Railway Ties.

A foreign contemporary in describing the method followed by the proprietors of the Eastern Railway Company for the creosoting of ties, etc., says that the sleepers as delivered are stacked and seasoned in the open air. They are then adzed and bored by a special machine, loaded on trucks and run into a drying oven, where they remain 24 hours or more. After drying at a temperature of about 176° F., they are run into a metal cylinder 6 feet 3 inches in diameter and 36 feet long, which is hermetically closed. The air is then exhausted, and a partial vacuum is maintained for about half an hour. Communication is then opened with reservoirs of dead oil, which is allowed to flow in at a temperature of 176° F., under pressure. When the oil ceases to flow under moderate pressure, it is forced in by a pump up to a pressure of 83 pounds per square inch, and this pressure is maintained for an hour or an hour and a quarter. Communication with the oil reservoirs is then opened again, and the excess of oil not absorbed by the timber flows back into the reservoir.

The cylinders hold 168 sleepers each. The quantity of oil absorbed is measured by determining the difference in volume of the oil before and after operation. The wood used is principally oak and beech. The oak sleepers absorb from 2.4 to 2.7 quarts per cubic foot; beech sleepers from 8.7 to 10 quarts per cubic foot. The whole operation takes about 4 hours. This method of treatment has been practiced by the company since 1865, with, it is stated, very good results. After 15 years of service the sleepers taken out have been 15 per cent. for creosoted oak and 50 per cent. for creosoted beech.

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

OBITUARY—PROF. SILAS H. DOUGLAS.—Once more we are called upon to chronicle the death of an engineer who was held in high repute by his fellows, and whose lifetime and work are models of all that rest on capacity, industry, ability, and honor. Indeed it is with deep regret that we say to the fraternity, Prof. Silas Hamilton Douglas, of Ann Arbor, Michigan, was called to rest on the evening of August 26. To the courtesy of a correspondent we are indebted for the following particulars respecting his career:

Prof. Silas H. Douglas, the oldest survivor of the ex-Professors of the University of Michigan, died at his home in Ann Arbor on the evening of August 26. He had had a paralytic stroke three years ago, and has been an invalid ever since. Prof. Douglas was born at Fredonia, Chautauqua county, N. Y., on October 27, 1816. He graduated from the University of Vermont, and subsequently took a Master's degree from the same Institution. In 1838 he came to Michigan, locating in Detroit, where he studied medicine with Drs. Rice and Pitcher. He graduated in this branch of his studies from the University of Maryland and returned to Detroit, where he was connected with the Geological Survey and with a Government Division for the negotiation of treaties with the Indians. In 1843 he moved to Ann Arbor, where he began the practice of a physician. In 1844 he was appointed Assistant Professor of Chemistry at the University, and two years later was advanced to a full Professorship of the same branch, filling this and other positions in the University until 1875. He was largely instrumental in the establishment of the medical and chemical departments of the University, and had charge of the erection of the observatory, the medical building, the chemical laboratory, the south wing of the main building, and the University system of water works. He twice served the city as Mayor, and under his rule many reforms were adopted, the greatest being the present system of license for the liquor traffic, which has resulted in such great benefit to the city. In 1859 he organized the Ann Arbor Gas Company, and for over 20 years has been President of the corporation. He was married in 1845 to a Miss Helen Wells, who died in 1880. Seven children survive him: Kate, Alice H., William W., Sarah L., Louise, and Henry W., all now of Ann Arbor, and Samuel T. Douglas, of Detroit. He was a brother of Judge Samuel T. Douglas, of Detroit, and of Mrs. Lydia Almond, of Portland, Oregon. The funeral services were celebrated at the family residence, on the afternoon of August 28th, and so great was the desire of the people to pay respect to the memory of their fellow townsman and leader that business in the city was virtually suspended."

The above is so clear and concise that we can add but little in a general way to tell the story of his life. We can, however, supplement it somewhat by referring to his career as a gas man, which is marked by the same studiousness and success that characterized his way in the other professions that he adorned. His business management of the Ann Arbor Gas Company needs no elaboration at our hands. The history of his Company, which is a record of unbroken success, attests to his fealty to its interests. And as its virtual engineer for almost a double decade, he was ever to be found abreast of the best practice of the times. Nor was he content to follow in the adoption of that which had been tried and proved, since we find that he could originate as well as copy. To him, perhaps more than to any one else in this country, do we owe many advances in the art of gas purification, and in the adoption of many smaller ends to attain maximum economies. He was an ardent advocate of our gas associations, and the records show that he was elected to membership in the Western, on the occasion of its fifth annual meeting, became affiliated with the American at its Thirteenth Annual, and was also on the Honorary roll of the Ohio. Frequently at these gatherings was his voice heard in counsel and command, and no man was listened to with greater attention or respect. Despite his advanced years, prior to the paralytic stroke that weakened his frame, no other intellect was more vigorous than his, and no one took greater delight in imparting to his fellows from his store of wisdom that which would guide them over the rough places that marked their pathways. Of course, it seems superfluous to say that in the death of Prof. Douglas a bright light in our profession has been extinguished, but only after a long span of years that sparkled with uprightness, merit and success.

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A CORRESPONDENT, writing from Atlanta, Ga., under date of August 29, says: "Dear JOURNAL: Visiting by chance Savannah, this week, I was deeply impressed with the many characteristics alone belonging to that old city. The rapid growth of Savannah has, perhaps, modernized the outer districts, but throughout the older portions, where our Southern Fathers enjoyed the many happy days of yore, one sees the manner in which that city was built for comfort. Squares to the right and left, with their numerous shade trees, in which you find monuments to the brave for their acts of self-sacrifice; old homesteads, still picturesque in their quaint styles, and many historic buildings, among which the house where Sherman made his headquarters during our troubles. Truly, does 'time work wonders,' and to-day Savannah may be said to be one of the most progressive cities in our Union. The business push of her worthy citizens shows plainly the direction the city must take. Already we find one of the finest hotels in the land—excelled possibly only by the palace at St. Augustine, Fla.—a model of beauty and comfort. A thorough investigation made on my visit proved that no money had been spared to make this hotel one of the spots in which man can thoroughly enjoy himself, and find rest and comfort after a weary journey. And what must be of interest to the gas engineers who propose to attend the coming convention of the American Association at Savannah, is that its doors will be opened for the first time on October 13th next, to receive them and their guests after their journey South. Words fail to describe the perfect construction of this Hotel De Soto. In every appointment it surpasses anything else that I have seen. The grand entrance opens from a porch or veranda, 30 feet by 50 feet, the general plan and disposition of the hotel being such that occupying three sides of the parallelogram, the third, towards the southeast, is left, and is to remain open for the free influx of light, sunshine and the southerly breeze from the ocean. The space thus thrown open is laid out in walks and lawns, with tennis courts, fountains, smokers' seats, orchestra pavilion, orange trees—in fine, all that goes to make up the sum of loveliness of a Southern garden, so delightful and novel to the eyes of the gas man. Can any overworked gas engineer fail to feel proud when he thinks that the De Soto will be opened a month in advance of the allotted time, simply because he is coming? I hope not. This will be done, and great credit must be given to the local committee for thus providing for our comfort, and all who can must indeed attend this convention, thereby showing their appreciation of effort made and the success obtained for their guests' comfort. Not alone has thought been given to the engineer; far more, I might say. Everything has been made the pink of perfection for the comfort of the ladies. We well remember what a convention was held in Baltimore, and when I recall the continuous round of enjoyment, I can say surely, from what I could learn, that Savannah will certainly try to outstrip 'old Baltimore's' hospitality, and show our people what they receive when they put themselves in the care of those who extend to us the hand of pure Southern hospitality. It is, I understand, the earnest hope that not alone a large attendance of gas engineers will be witnessed at the convention, but the expectation is that many ladies will also be present—even more than last year, if possible. I am glad, indeed, that I happened through Savannah, and I feel sure that if our members take advantage of the opportunity to attend this coming convention and look over Savannah, they will not regret the journey or any trouble they may have had in making the trip. Yours truly, D. H. C."

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AT the organization meeting of the Board of Directors of the Lincoln (Neb.) Gas Company the following officers were re elected: President, H. J. Walsh; Vice-President, C. W. Mosher; Treasurer, R. C. Outcalt; Secretary, J. K. Honeywell. The Company is in excellent shape for the coming winter campaign.

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PRESIDENT STEINWEDELL and Manager Littleton, of the Quincy (Ills.) Gas Light and Coke Company are again to the front with an announcement to the consumers that gas rates have been reduced. The "official" announcement of the fact, as seen from the advertisement printed in the local papers, is as follows: "The Quincy Gas Light and Coke Company, beginning with the first day of August, 1890, will sell gas for lighting purposes at the rate of $1.75 per 1,000 cubic feet, and for fuel at $1.25 per 1,000, and will allow on the above rates a discount of 25 cents per 1,000 cubic feet, providing bills for the preceding month are paid on or before the 10th day of the following month, as hereinafter stated. Payments beginning with gas used during the month of August must be made at the new office of the Company, No. 434 Maine street. A statement of the account of each consumer will be rendered on or soon after the first day of each month. In order to secure the above discounts payments must be made as herein stated, as outside collections will not be made hereafter by any agent of this Company." The advertisement, however, does not fully show the practice of the Company in respect to rates, in that a further rebate of 10 per cent. is granted on the bills of all consumers who have used 50,000 cubic feet or over during the month. This last concession means a net rate of $1.35 per 1,000, and comment

on the liberality of such a figure is certainly superfluous. That is the way to "blast the hopes" of opposition schemers, and to add to the coin in the Company's treasury.

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DEALERS in residual products have been greatly perturbed this summer over the rise in price of refined ammonia, and it is quite likely that the advance will be maintained for at least a year to come. A correspondent, in the course of some remarks on the situation, says: "The wholesale price of concentrated liquid ammonia has recently advanced from 5¼ cents to 9 cents, and a fortnight or so ago it was extremely difficult to get enough to supply the demand, even at that price. The immediate cause of this great advance in price is, of course, due to the unexpectedly large orders from the manufacturers of artificial ice which have been pouring in upon the ammonia products handlers all summer. The increase in the quantity of water gas that is being manufactured, and the greatly decreased demand for gas in the summer months over that existing in the winter season, account for the scarcity of ammonia products just now, particularly as the demand for the latter has never been so brisk. I am not alone, either, in the belief that the time is coming when manufactured ice will be sold in New York fully as cheap as the natural article, even after a good, old-fashioned ice-making winter. —AMMONIA."

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THE authorities of Lincoln, Nebraska, have ordered Gas Inspector Flaherty to see to it that all the gas lamps in the city should be in readiness for lighting the streets before the opening of the State Fair, which was to be formally opened on Friday last. This is a case of the survival of the fittest, in that gas supersedes electricity for street lighting purposes at Lincoln.

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THE following rather curious descriptive and sweeping statements respecting the success attending the use of artificial fuel gas at the Beaver Falls (Pa.) works of Messrs. Carnegie, Phipps & Co., are taken from the Pittsburgh *Dispatch*, dated August 29: "In connection with the recent discussion on the supply of natural gas, it will be interesting to notice the results obtained from the producers of artificial gas which are now in operation at the Beaver Falls plant of Carnegie, Phipps & Co. The producers in use there are patented by Martin V. Smith, the well-known metallurgical engineer of this city, and are generally conceded to be adapted to rolling mill purposes. The plant comprises eight producers, each producer being enlarged above the grates. The area of the uptake at the point where it enters the collecting main is twice as large as where it leaves the heating chamber. This construction admits of a free expansion of the gases and obviates back pressure on the coal—the latter is a serious matter where it occurs; for there is little use in generating gas if it cannot be taken from the generators without waste. A water jacket surrounds the downcomer and cools the gas which is dry and carried to the furnaces through the mains without the latter becoming clogged with water. The main flue from the producers is 60 inches by 54 inches, inside measurements, and decreases to 48 inches square beyond the first two furnaces. Two 7 feet by 15 feet furnaces at the extreme right, distant 160 feet from the producers, are supplied by a straight main, 42 inches by 38 inches. The producers in this mill are at the end of the plant, but it is held that they may be placed between the furnaces, thus decreasing the condensation, or back pressure, in long distances. The mill is now run on wire rod and has seven heating furnaces in all. The consumption of coal with these producers at first was 411 pounds to the gross ton of iron shipped. Later on improvements were effected which decreased the consumption of coal to 300 pounds per ton of iron. The average consumption of coal last year was 280 pounds per ton of finished stock. About 159,000 cubic feet of gas have been obtained from one ton of coal, and each producer will use 5 tons of coal every 24 hours, thus producing 795,000 cubic feet in the time mentioned, or 6,360,000 cubic feet for the entire plant in 24 hours. On a basis of coal at $1 per ton delivered at the mill, the cost of gas runs from 1 cent per 1,000 cubic feet, for the cheapest grade, to 5 cents for first-class fuel. The gas used in ordinary iron and steel metallurgical works costs from 1½ cents to 2 cents per 1,000 cubic feet. It is claimed that the repairs on this description of plant will not exceed 5 cents per ton of 'iron heat,' and it is generally held to be both economical and convenient. It is generally held that these artificial gas producing plants will, in time, be called into requisition to supplement the natural gas supply, and that the system will be universally adopted as against a return to coal. It is argued that both workers and manufacturers have become used to the gas, and have both based their prices on its use. Neither, it is held, would care to return to coal because of the increased cost attending its use. If natural gas ever should give out, its place will be taken by the artificial producer article."

AT a recent meeting of the Street Lighting Committee of Deerpark, N.Y., a report to the Board of Trustees respecting the public lighting of the village was prepared. Bids were received from three parties, which in substance were as follows, a partial moon table to be followed: Deerpark Electric Light Company, for first 83 arcs (2,000 candle power), $105 each per annum, and $90 for each additional arc; the Port Jervis Gas Light Company, $22 per post, as far as the Company's mains extended, the city to furnish posts, lamps, etc., and to repair all breakages; the N. Y. and N. J. Globe Gas Light Company, naphtha lamps, at $21.50 per post. Subsequently this report was handed to the Trustees, when, on motion of Mr. Quick, it was received and filed. This action was followed by a resolution from Mr. Burkett to the effect that a contract be made with the Deerpark Company for the lighting in accordance with its proposition, the agreement to run for 2 years. This was agreed to, and the Clerk was instructed to draw up the necessary papers.

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MR. C. B. HAYWARD, City Clerk, Dayton, O., advertises that sealed proposals for lighting the streets of that city, by means of gas, electricity, or gasoline, according to specifications on file in his office, will be received up to 3 P.M. of Monday next.

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JUDGE KNOWLTON will, in accordance with his decision of a fortnight ago, listen to the arguments of 10 taxpayers of the town of Peabody, Mass., respecting their application to him for an injunction to restrain the town from expending $30,000 in establishing an electric lighting plant, under a contract with the Edison General Electric Company.

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THE Committee on Light, Cincinnati Councils, met on August 28 to consider the proposed ordinance for the Queen City Natural Gas and Fuel Company. No one was present to speak for the Company, but Isaac Jordan, on behalf of certain taxpayers who oppose the ordinance, made a short address, in which he asked that the Committee appoint a date on which they could offer a set argument. President Hickenlooper was present, but only as a spectator and listener. After a desultory discussion, the Committee named to-day as the date on which to hear Mr. Jordan's argument.

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SOMETHING over a week ago President C. E. Judson, of the Hyde Park Gas Company, made a formal demand on Street Commissioner Purdy, of Chicago, for a permit to lay 8-inch gas mains on the following streets and avenues in the city: From 39th street to South Chicago avenue, along Cottage Grove avenue; 71st to 95th street, from Erie avenue to Ewing avenue, Ewing avenue to Indiana boulevard, Indiana boulevard to 106th, and on Erie avenue, from 95th to 96th street. Also, for a permit to locate and construct a brick tunnel for the conveyance of gas pipes under the Calumet river, from a point about 20 feet south of the center line of 95th street, and from a point about 20 feet east of the dock line; the shaft of the tunnel to be circular in section, and 8 feet in diameter. The Commissioner, who seemed to be much worked up over this simple demand, at once took counsel with the corporation attorney (Mr. Hutchinson) and Superintendent McGann. There the ordinances of the Hyde Park Company (as originally granted the Company, June 24, 1871; November 25, 1871; March 25, 1875) were hastily examined, with the result that Mr. Hutchinson delivered the following opinion: He held that the Commissioner had no discretion in regard to granting the permit for the several street rights asked for, but so far as the tunnel under the Calumet river was concerned, he claimed the city had no jurisdiction. The Government owns the bed of the river in fee, having obtained it with the riparian rights from the property owners for deepening the channel and widening the stream. The city can build no bridges across it without an act of Congress, however much the people residing there might demand them. He admitted that the Fort Wayne Railroad had erected a bridge across the Calumet river without governmental permission, but explained that the authorities at Washington could order it torn down as an obstruction to navigation; hence the city could grant no rights over or under the Calumet river. When the matter was placed before Mayor Cregier he decided that the permit should not be granted until the same had been passed upon by Councils. Those familiar with the location will fully understand why the right to use the streets petitioned for would be useless to the Hyde Park Company unless it were accompanied by the right to cross the Calumet river, and the whole thing is evidence of the incompetence or worse of the authorities of Chicago in their dealings with the gas suppliers of the city. Could anything be more absurd than to suggest that the "commerce of the Calumet river" could be in any sense interfered with by the placing of a pipe line underneath its muddy bed? The pretense has not even the merit of a makeshift.

A HINT from Macon, Ga., is to the effect that the improvements on the local gas plant that have been undertaken by Superintendent Wilcox will more than double the capacity of the works.

THE annual meeting of the Manitoba Gas and Electric Light Company has been postponed for a fortnight.

MR. J. P. WHITTIER, mason and contractor for gas works construction, with headquarters at Brooklyn, N. Y., writes us under date of the 2d inst.: "I am pleased to inform you that the gasholder tank and mason work at Flatbush, L. I., were completed in 70 days from the time the work was started. I have just finished 11 benches of 6's at the Nassau works, Brooklyn, N. Y., and have made repairs on the regenerative furnaces at the same plant. My work in hand includes two benches of 6's at Mount Vernon, N. Y., 4 benches of 6's at Bridgeport, Conn., and are tearing out, at the Brooklyn (N. Y.) works, 28 benches. The material from the latter I will prepare for sale as ground firebrick, of which material I expect to have 4,000 barrels for sale. I am also building a new gasogen house for the Flatbush Company."

THE Exeter (N. H.) gas reduction (from $2.80 per 1,000 cubic feet to $2.50 per 1,000) takes effect on October first.

THE proprietors of the Kittaning (Pa.) Gas Company are taking up the old wooden mains to replace them with cast iron pipes. Strange to say, many of the wooden pipes are in a very good state of preservation.

THE Elgin (Ills.) American Gas Company's plant is to be greatly improved. The management of the Company gives great satisfaction to the residents.

AT the annual meeting of the Providence (R. I.) Gas Company the following result was reached: Directors, Col. Wm. Goddard, Hon. Amos C. Barstow, ex-Governor Royal C. Taft, and Messrs. A. B. Slater, Edward Pearce, Jesse Metcalfe, G. W. R. Matteson, Lucien Sharpe and Newton D. Arnold. President, Hon. A. C. Barstow; Vice-President, Col. Wm. Goddard; Secretary and Treasurer, Mr. A. B. Slater.

THE deal under which it was sought to consolidate the interests of the Bath (Me.) Gas Light Company and the Bath Electric Light and Power Company has been completed.

MR. GEORGE C. BLADES is very much encouraged over the success he is meeting with in securing signatures for prospective gas consumers for the new Framingham (Mass.) Gas, Fuel and Power Company.

AT a meeting of the Citizens Gas Company, of Wakefield, Mass., held for the purpose of reorganizing under the recent combination with the Wakefield Electric Light Company, the following officers were chosen: Directors, Charles F. Woodward, Ezra N. Southworth, R. P. Buzzell, H. C. Buck, F. E. Smith, E. R. Champlin and J. F. McCrillis; Treasurer, H. C. Buck; Clerk, F. E. Smith.

THE main system of the Marlboro (Massachusetts) Company's is being thoroughly overhauled.

THE capital stock of the Calumet Gas Company (Chicago) has been increased to $1,000,000.

THE Equity Gas Works Construction Company, of Jersey City and New York, has been incorporated by Messrs. David Scott and August C. Manz, of New York city, and W. P. S. Melvin, of East Orange. It is capitalized in $500,000. According to the articles filed, the corporation is organized for the purposes "of constructing gas and electric buildings and works and plants, and acquiring works of gas and electric light companies, and securities of such companies."

THOSE interested say that the South Side Gas Company, of Pittsburgh, Pa., is still in the possession of its original proprietors. The Philadelphia syndicate, however, has examined the plant with a view to making a bid for the same.

THE Trades and Labor Assembly, Nationalist Club, and Single Tax League, of Minneapolis, Minn., are a unit in advising the authorities to install and operate a municipal lighting plant. Their prayers have been coldly received; that is, up to date.

## Shall we Bake and Cook by Electricity?

The *Metal Worker* says that as electricity is at present only in its infancy, the not very distant future is likely to witness developments concerning it which will prove as remarkably surprising as any of those with which the world is now familiar. The variety of uses to which the electric current may be put are manifold, and through the untiring energy of the inventive mind the number is constantly increasing. To enumerate them would be a difficult task, but it may be stated in very general terms that the use of electricity is found in almost every branch of industry, and that for domestic purposes its possibilities are being carefully considered. Those in the stove trade who have been alert to what was going on in the world of interest to them cannot have failed to notice a succession of patents which have lately been issuing from the United States Patent Office to Col. J. A. Price, of the Scranton Stove Works, Scranton, Pa., involving a radical modification of the system of ventilation now so extensively adapted to stove construction. By degrees the development has become more and more pronounced, until, in the issue of the *Patent Office Gazette* bearing date of July 29, the inventor broadly hints at electrical expression in his handling of the air currents in the oven. The approach to this result is gradual, and is characterized by considerable caution in the following quotation: "The currents of air so produced also seem to exert an electrical effect in the oven, which I attribute to the movement and heated application to the oven, as there is an intensity of action not otherwise accounted for."

From this it is not surprising that many in the trade are curious regarding the investigation of Colonel Price, who is certainly no novice in the art of stove construction, and who, besides, has been a liberal patron of the Patent Office at Washington. Everyone knows that science and the mechanic arts are on the tiptoe of expectation in regard to the ability to excite the electric current without the aid of the dynamo and initial power, or in other words, directly from heat or some kindred element. The expressions employed by Mr. Price in his patent specification would seem to indicate that he is on the track of something having a wider significance than the mere preparation of food, and it is perhaps fair to assume that it can be no other than that concerning which expectation is aroused. It may be assumed that eventually electricity will be evolved directly from heat, and it may come by way of suggestion and perhaps accomplishment from the kitchen stove or elsewhere. All will certainly hope for success to one of the craft, and will wait with no little curiosity for the issue of Col. Price's bold push into the present comparative obscurity and confusion.

In regard to the oven, the system inaugurated appears to be one of a lower temperature than is generally necessary to do effective work, or lower than has ordinarily been considered safe. The claims are that even with this condition established more rapid service can be attained, while the loss through destructive distillation is greatly reduced. The inventor says: "The products may be said to be oxygenated instead of carbonized, * * * and thus become a useful factor, combining, so to speak, a chemical with the mechanical action of the air."

## The Market for Gas Securities.

Money was somewhat easier during the week, and the result was an improvement in prices on the Stock Exchange, Consolidated gas, of course, sharing in the advance. To-day (Friday) 98 is bid, sellers asking one-half point more. It is a noteworthy fact that during all the depression less than 5,000 shares changed hands, and it is quite certain that 60 per cent. of the nominal transactions were washed sales. Equitable keeps fairly up to the lately recorded high figures that were made in it, and is freely bid for at 126 to 128, with virtually no stock being offered. Mutual is rather weaker, that is, in respect to nominal bid figures, which are reported at 120 to 122. We make no doubt that any fair sized block could not be purchased under 124. Standard preferred is at 85 to 90, the common going at 40 to 45. Brooklyn shares are all strong and higher, which verdict applies prominently to the Fulton Municipal, shares in that Company being in demand at 144 to 147. Baltimore Consolidated is at 50½ to 51, and at these figures seems to us a purchase. Chicago gas is at 53¼, with every indication that higher values will soon be recorded respecting it. Laclede common is about as before—19 to 20—but there is more confidence in it now than has been shown for some time back. The "strikers" are again at work in Cincinnati, but it is not likely that the Queen City Company's backers will ever cause General Hickenlooper much trouble. The greatest illustration that can be referred to in evidence of the growth of the gas business in the Southwest and on the Pacific Coast is to look over the improvement plans, calling for the expenditure of large sums of money, that have been perfected in several States, notably Texas and California. We look for an exceptionally strong general market this winter.

## Gas Stocks.

**Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,**

16 Wall St., New York City.

September 8.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

| | Capital. | Par. | Bid | Asked |
|---|---|---|---|---|
| **Consolidated** | $35,430,000 | 100 | 97½ | 98½ |
| **Central** | 500,000 | 50 | 90 | 100 |
| " Scrip | 220,000 | — | 95 | 100 |
| **Equitable** | 4,000,000 | 100 | 126 | 128 |
| " Bonds | 1,000,000 | — | 113 | 115 |
| **Harlem, Bonds** | 170,000 | — | — | — |
| **Metropolitan, Bonds** | 658,000 | — | 115 | — |
| **Mutual** | 3,500,000 | 100 | 120 | — |
| " Bonds | 1,500,000 | — | 100 | 102 |
| **Municipal, Bonds** | 750,000 | | — | — |
| **Northern** | | 50 | — | — |
| " Bonds | 150,000 | — | — | 100 |
| **Standard Gas Co—** | | | | |
| Common Stock | 5,000,000 | 100 | 40 | 45 |
| Preferred | 5,000,000 | 100 | 85 | 90 |
| **Yonkers** | | 50 | 112 | — |
| **Richmond Co., S. I.** | 346,000 | 50 | — | — |
| " Bonds | 20,000 | — | — | — |
| **Gas Co's of Brooklyn.** | | | | |
| **Brooklyn** | 2,000,000 | 25 | 120 | 123 |
| **Citizens** | 1,200,000 | 20 | 92½ | 93¼ |
| " S. F. Bonds | 320,000 | 1000 | 100 | 103 |
| **Fulton Municipal** | 3,000,000 | 100 | 144 | 147 |
| " Bonds | 300,000 | | 100 | 105 |
| **Peoples** | 1,000,000 | 10 | 98 | 100 |
| " Bonds (7's) | 368,000 | — | 100 | — |
| " " (6's) | 94,000 | — | 100 | — |
| **Metropolitan** | 1,000,000 | 100 | 109 | 111 |
| **Nassau** | 1,000,000 | 25 | 130 | — |
| " Ctfs | 700,000 | 1000 | 100 | 102 |
| **Williamsburgh** | 1,000,000 | 50 | 131 | — |
| " Bonds | 1,000,000 | — | 108 | 112 |
| **Out of Town Gas Companies.** | | | | |
| **Boston United Gas Co.—** | | | | |
| 1st Series S.F. Trust | 7,000,000 | 1000 | 93 | 93½ |
| 2d " " " | 3,000,000 | 1000 | 71 | 72 |
| **Bay State Gas Co.—** | | | | |
| Stock | 5,000,000 | 50 | 85 | 86 |
| Income Bonds | 2,000,000 | 1000 | 95½ | — |
| **Buffalo Mutual, N. Y.** | 750,000 | 100 | 90 | 95 |
| " Bonds | 200,000 | 1000 | 95 | 100 |
| **Citizens, Newark** | 1,000,000 | 50 | 155 | 160 |
| " " Bonds | 45,000 | — | — | — |
| **Chicago Gas Company** | 25,000,000 | 100 | 53¼ | — |
| **Chicago Gas Light & Coke Co.—** | | | | |
| G't'd Gold Bonds | 7,650,000 | 100 | — | 92½ |
| **Equitable Gas & Fuel Co., Chicago, Bonds** | 2,000,000 | 1000 | — | 98 |
| **People's Gas and Coke Co., Chicago—** | | | | |
| 1st Mortgage | 2,100,000 | 1000 | — | 100 |
| 2d " | 2,500,000 | 1000 | 94 | 98½ |

## Advertisers Index.


**GAS ENGINEERS.** Page

Jos. R. Thomas, New York City ... 349
Wm. Henry White, New York City ... 355
Wm. Mooney, New York City ... 349
Fred. Bredel, N. Y. City ... 351

**GAS AND WATER PIPES.**

Gloucester Iron Works, Phila., Pa ... 349
Mellert Foundry and Machine Co., Reading, Pa. (John Fox, Selling Agent, N. Y.) ... 349
Ohio Pipe Co., Columbus, Ohio ... 349
M. J. Drummond, New York City ... 349
R. D. Wood & Co., Phila., Pa ... 354
Warren Foundry & Machine Co., New York City ... 349
Donaldson Iron Co., Emaus, Pa ... 349
Dennis Long & Company, Louisville, Ky ... 349
Spiral Weld Tube Company, New York City ... 349

**GAS WORKS APPARATUS AND CONSTRUCTION.**

James R. Floyd & Sons, New York City ... 355
Continental Iron Works, Greenpoint, L. I ... 355
Delly & Fowler, Phila., Pa ... 355
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 352
Stacey Mfg. Co., Cincinnati, Ohio ... 355
Bartlett, Hayward & Co., Baltimore, Md ... 353
Morris, Tasker & Co., Limited, Phila., Pa ... 358
Davis & Farnum Mfg. Co., Waltham, Mass ... 352
R. D. Wood & Co., Phila., Pa ... 354
Bouton Foundry Co., Chicago, Ills ... 355
Isbell-Porter Company, New York City ... 354
Fred. Bredel, N. Y. City ... 351
United Gas Improvement Co., Phila., Pa ... 345
National Gas Light and Fuel Co., Chicago, Ills ... 346
Simpkin & Hilliyer, Richmond, Va ... 339
Berlin Iron Bridge Company, East Berlin, Conn ... 308

**PROCESSES.**

National Gas Light and Fuel Co., Chicago, Ills ... 346
Bartlett, Hayward & Co., Baltimore, Md ... 353
United Gas Improvement Co., Phila., Pa ... 345

**INCLINED RETORTS.**

Laclede Fire Brick Manuf'g Co., St. Louis, Mo ... 340

**GASHOLDER TANKS.**

W. C. Whyte, New York City ... 346
J. P. Whittier, Brooklyn, N. Y ... 347

**GASHOLDER PAINT.**

The Government Waterproof Paint Co., Boston, Mass ... 341

**RETORTS AND FIREBRICK.**

J. H. Gautier & Co., Jersey City, N. J ... 350
B. Kreischer & Sons, New York City ... 350
Adam Weber, New York City ... 339
Laclede Fire Brick Manuf'g Co., St. Louis, Mo ... 350
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y ... 350
Borgner & O'Brien, Phila., Pa ... 350
James Gardner, Jr., Pittsburgh, Pa ... 350
Henry Maurer & Son, New York City ... 351
Chicago Retort and Fire Brick Co., Chicago, Ills ... 350
Baltimore Retort and Fire Brick Co., Baltimore ... 350
Oakhill Gas Retort and Fire Brick Co., St. Louis, Mo ... 350
Boston Fire Brick Works, Boston, Mass ... 350

**SCRUBBERS AND CONDENSERS.**

G. Shepard Page, New York City ... 314
R. D. Wood & Co., Phila., Pa ... 354
James R. Floyd & Sons, New York City ... 348

**REGENERATIVE FURNACES.**

Bartlett, Hayward & Co., Baltimore, Md ... 353
Fred. Bredel, New York City ... 351
Chicago Retort and Firebrick Co., Chicago, Ills ... 350
J. H. Gautier & Co., Jersey City, N. J ... 351
Adam Weber, New York City ... 339

**GAS GOVERNORS.**

Connelly & Co., New York City ... 347
Fred. Bredel, N. Y. City ... 351
Friedrich Lux, London, England ... 342

**SELF-SEALING MOUTHPIECE DOORS.**

Isbell-Porter Company, New York City ... 354

**TAR AND CARBONIC ACID EXTRACTOR.**

Geo. Shepard Page, N. Y. City ... 308

**CEMENTS.**

C. L. Gerould & Co., Brooklyn, N. Y ... 350

**GAS ENRICHERS.**

Standard Oil Co., Cleveland, Ohio ... 356

**GAS METERS.**

John J. Griffin & Co., Phila., Pa ... 358
American Meter Co., New York and Philadelphia ... 359
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa ... 359
Helme & McIlhenny, Phila., Pa ... 359
D. McDonald & Co. Albany, N. Y ... 359
Nathaniel Tufts, Boston, Mass ... 358
Maryland Meter and Manufacturing Co., Baltimore, Md ... 303
Jones Meter and Stove Co., Royersford, Pa ... 358
Harris Bros. & Co., Philadelphia, Pa ... 358

**EXHAUSTERS.**

The P. H. & F. M. Roots Co., Connersville, Ind ... 340
Isbell-Porter Company, New York City ... 354
Wilbraham Bros., Philadelphia, Pa ... 347
Connelly & Co., New York City ... 347

**GAS COALS.**

Penn Gas Coal Co., Phila., Pa ... 357
Perkins & Co., New York City ... 356
Despard Coal Co., Baltimore, Md ... 357
Chesapeake and Ohio R. R. Coal Agency, N. Y. City ... 357
Westmoreland Coal Company, Phila., Pa ... 357
J. & W. Wood, New York City ... 356

**CANNEL COALS.**

Perkins & Co., New York City ... 356
J. & W. Wood, New York City ... 356

**VALVES.**

Ludlow Valve Manufacturing Co., Troy, N. Y ... 339
John McLean, New York City ... 339
Chapman Valve Manufacturing Co., Boston, Mass ... 339
R. D. Wood & Co., Phila., Pa ... 354
The P. H. & F. M. Roots Co., Connersville, Ind ... 340

**GAS ENGINES.**

Schleicher, Schumm & Co., Phila., Pa ... 360
Clerk Gas Engine Co., Phila., Pa ... 357
Van Duzen Gas Engine Co., Cincinnati, Ohio ... 357

**ENGINES AND BOILERS.**

Jarvis Engineering Co., Boston, Mass ... 347

**STEAM PUMPS.**

Van Duzen & Tift, Cincinnati, Ohio ... 339

**GAS LAMPS.**

Welsbach Incandescent Gas Light Co., Phila., Pa ... 341
The Siemens-Lungren Company, Philadelphia, Pa ... 341
Fiske, Coleman & Company, Boston, Mass ... 350

**PURIFIER SCREENS.**

John Cabot, New York City ... 342
Bartlett, Hayward & Co., Baltimore, Md ... 342

**GAS STOVES.**

American Meter Co., New York and Philadelphia ... 343
The Goodwin Gas Stove and Meter Co., Phila. Pa ... 324
George M. Clark & Company, Chicago, Ills ... 342
D. McDonald & Co., Albany, N. Y ... 359
Maryland Meter and Manufacturing Co., Baltimore, Md ... 303
Jones Meter and Stove Co., Royersford, Pa ... 358
Chicago Gas Stove Company, Chicago, Ills ... 342
Dangler Stove and Mfg. Co., Cleveland, Ohio ... 342

**STREET LAMPS.**

J. G. Miner, Morrisania, New York City ... 341
Bartlett Street Lamp Man'fg Co., New York City ... 341

**BURNERS.**

C. A. Gefroner, Phila., Pa ... 336
Moses G. Wilder, Phila., Pa ... 341

**STEAM BLOWER FOR BURNING BREESE.**

H. E. Parson, New York City ... 304

**PURIFYING MATERIAL.**

Connelly & Co., New York City ... 347
Friedrich Lux, London, England ... 342

**COKE CRUSHER.**

C. M. Keller, Columbus, Ind ... 357

**ELECTRICAL APPARATUS.**

Wm. Henry White, N. Y. City ... 35
Fort Wayne Electric Co., Fort Wayne, Ind ... 348

**BOOKS, ETC.**

1890. Directory, 1890 ... 347
King's Treatise ... 339
Practical Electric Lighting ... 347
Electric Light Primer ... 347
American Gas Engineer and Superintendents' Handbook ... 351
Digest of Gas Law ... 339
Fuel and its Applications ... 339
Newbigging's Handbook ... 351



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| " " | 4,000 | " | 30 " | 2 00 |
| " " | 5,000 | " | 30 " | 2 00 |
| " " | 6,000 | " | 28 " | 2 00 |
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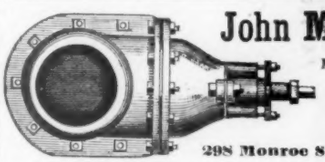

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FOR FIRING COAL GAS AND FIXING BENCHES, ALSO INCLINED AND VERTICAL RETORTS.

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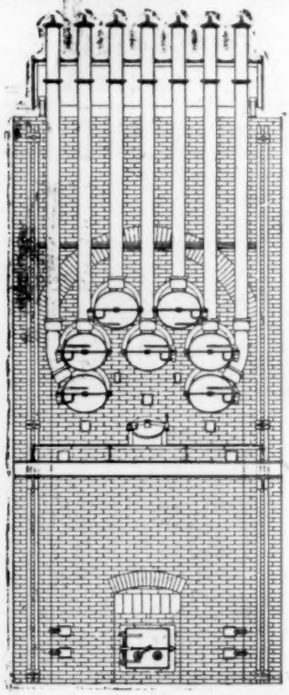

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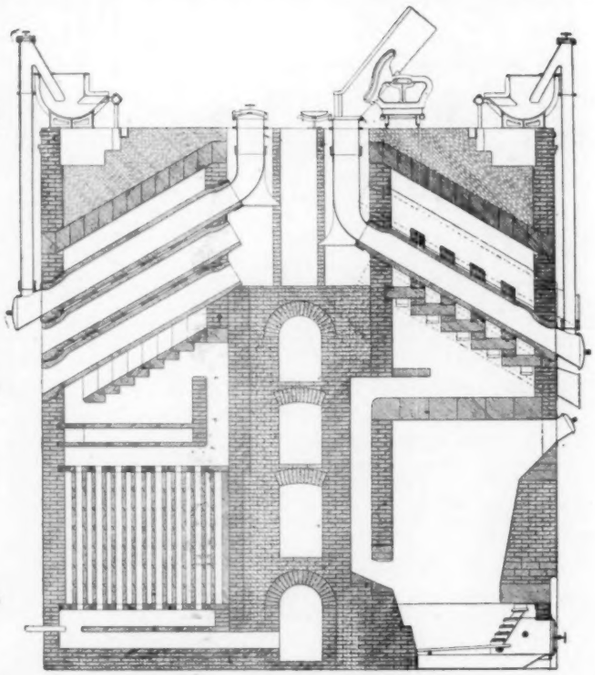
**IT IS THE COMING BENCH FOR MAKING COAL GAS.**

*It will Save from 50 to 60 per ct. in Labor.*



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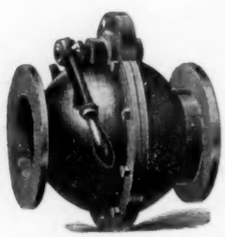

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Quick Acting,
Simple,
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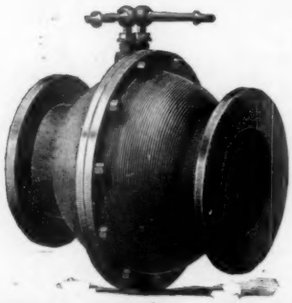

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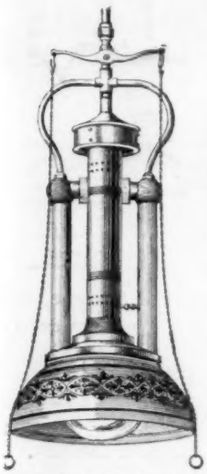

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A successful Competitor of the Arc Electric Light for lighting Store Fronts, Show Windows, Depots, Railway Sheds, etc., etc.

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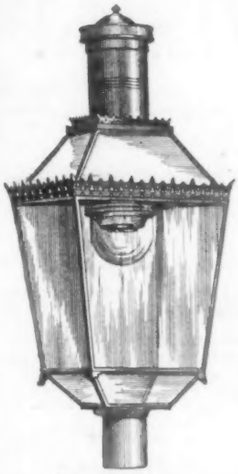

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# WELSBACH SYSTEM

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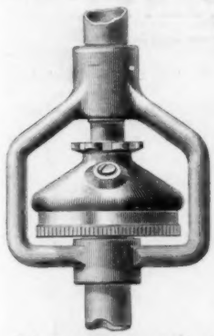
FOR GAS LAMPS & HIGH-POWER BURNERS.



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STREET LAMPS AND GENERAL USE,

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Specially adapted for GAS STOVES, FURNACES, Etc., Etc.

It is well known that a large majority of all High Power Gas Lamps in the United States have my Governors attached, and they are always used by the leading makers of these lamps. To remove any excuse for the use by anyone of inferior and infringing Governors, a reduction in price has been made, and all exclusive contracts are cancelled.

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## Bartlett Street Lamp Mfg. Co.

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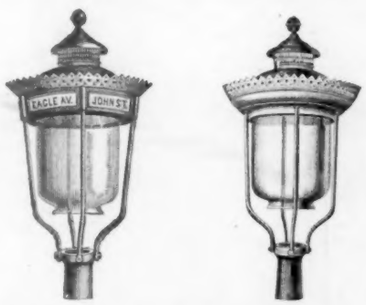


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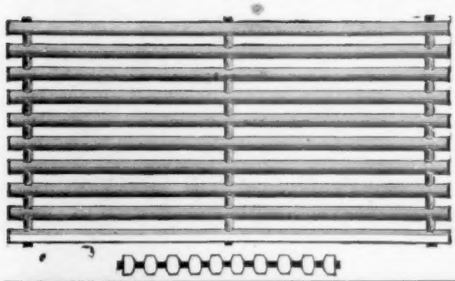

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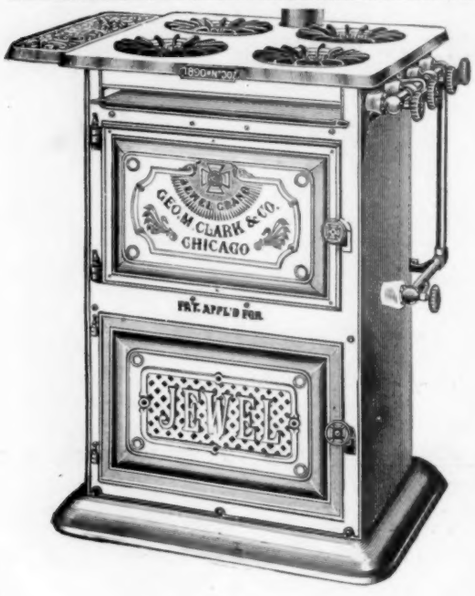


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**EVERY CONCEIVABLE SIZE AND STYLE.**

**Ranging in Prices from $1.50 to $37.00.**

**WE USE NO GAS COCKS.**

All Flames are Regulated by a Direct Needle Valve.

## The JEWEL

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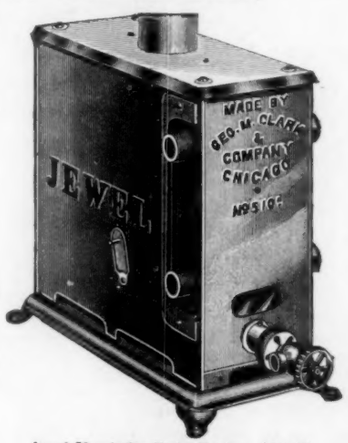


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Standard 3 Diaphragm Dry Meter.

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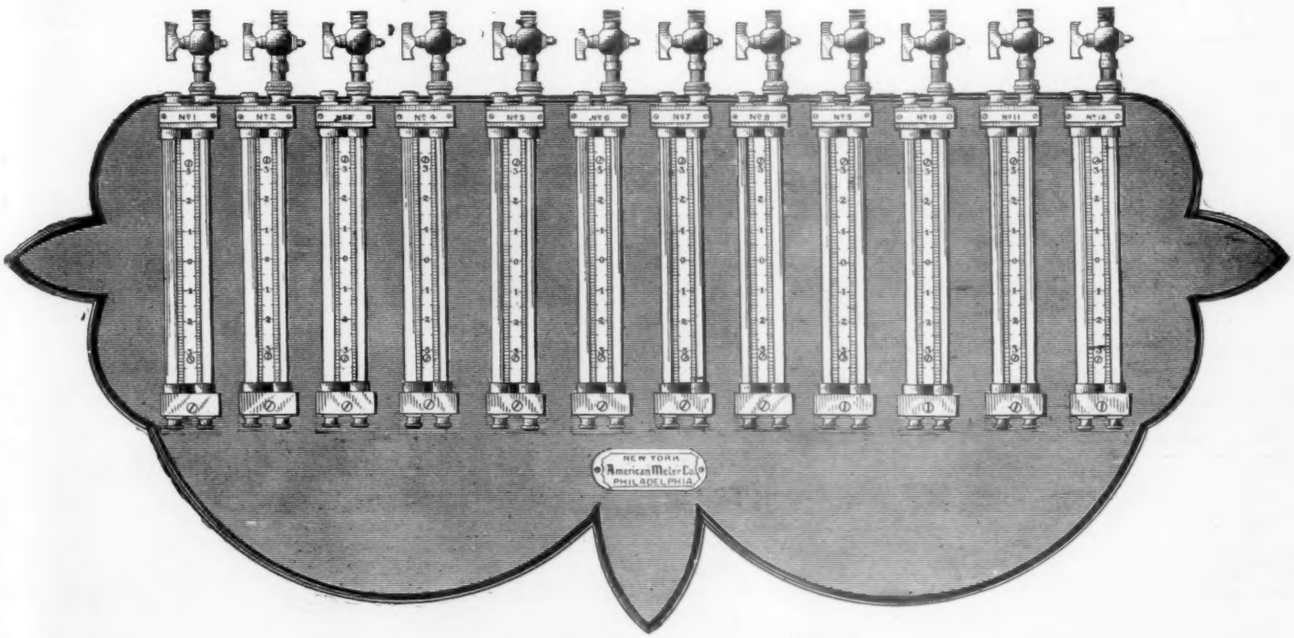


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## Erected and in course of construction at present date:

| | Capacity. Cubic feet per day. |
|---|---|
| Altrincham | 600,000 |
| Adelaide | 600,000 |
| Aldershot | 200,000 |
| **Allegheny, U. S. A** | 1,000,000 |
| Ashton-under-Lyne | 1,250,000 |
| Amsterdam | 1,500,000 |
| " | 1,500,000 |
| Annaberg | 200,000 |
| Arcachon | 100,000 |
| Animal Charcoal Co | 200,000 |
| **Altoona, U.S.A.** | 350,000 |
| Buxton | 250,000 |
| Bradford | 1,000,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,000,000 |
| " | 1,000,000 |
| " | 3,000,000 |
| Bremen | 150,000 |
| **Baltimore, U.S.A.** | 1,000,000 |
| " | 1,000,000 |
| " | 1,000,000 |
| Balmain, N.S.W | 125,000 |
| Bishops Stortford | 150,000 |
| Blackpool | 400,000 |
| Brussels | 1,250,000 |
| " | 1,250,000 |
| " | 750,000 |
| " | 1,250,000 |
| Banbury | 250,000 |
| Birmingham | 5,000,000 |
| Birkenhead | 2,500,000 |
| Blackburn | 1,500,000 |
| Bochum | 600,000 |
| Burntisland | 250,000 |
| **Boston, U.S.A.** | 2,000,000 |
| Brisbane | 1,500,000 |
| " | 300,000 |
| Burton-on-Trent | 1,500,000 |
| Barcelona | 350,000 |
| Barking | 100,000 |
| Baerlien & Co | 20,000 |
| " | 20,000 |
| Bombay | 400,000 |
| **Buffalo, U.S.A., Mutual** | 750,000 |
| " " **Citizen** | 500,000 |
| **Brookline, U.S.A.** | 500,000 |
| Bergen | 350,000 |
| Berlin | 1,250,000 |
| Bournemouth | 1,000,000 |
| **Bridgeport, U.S.A** | 500,000 |
| Brunswick | 300,000 |
| **Beck & Co., St. Louis** | 100,000 |
| Barmen Rittershausen | 600,000 |
| Bexhill | 125,000 |
| **Brooklyn, U.S.A** | 1,000,000 |
| " | 1,000,000 |
| " **Nassau** | 1,000,000 |
| Brunner, Mond & Co | 400,000 |
| Cheltenham | 2,000,000 |
| Cannes | 200,000 |
| Croydon | 1,500,000 |
| Copenhagen | 200,000 |
| Clevedon | 200,000 |
| **Columbus, U.S.A** | 500,000 |
| **Cincinnati,** " | 1,500,000 |
| " " | 1,500,000 |
| **Chicago** " | 3,000,000 |
| " " | 1,000,000 |
| " " | 1,000,000 |
| Chemnitz | 1,000,000 |
| Crewe | 1,250,000 |
| Colonial Gas Works Co | 100,000 |
| Cadiz | 300,000 |
| Charlottenburg | 600,000 |
| Dudley | 750,000 |
| Driffield | 100,000 |
| Dukenfield | 500,000 |
| Dover | 750,000 |
| " | 1,000,000 |
| Deal | 200,000 |
| Derby | 1,500,000 |

| | Capacity. Cubic feet per day. |
|---|---|
| Dublin | 3,000,000 |
| Dowlais | 100,000 |
| Douai | 500,000 |
| Denton | 500,000 |
| **Derby, U.S.A** | 350,000 |
| **Denver,** " | 500,000 |
| " " | 1,000,000 |
| Dusselldorf | 750,000 |
| " | 500,000 |
| Dumfries | 250,000 |
| Dunedin, N.Z | 400,000 |
| Darlington | 1,250,000 |
| **Detroit, U.S.A** | 750,000 |
| Edinburgh | 1,500,000 |
| " | 2,000,000 |
| Enfield | 300,000 |
| Essen | 300,000 |
| Elbing | 150,000 |
| Falmouth | 150,000 |
| Frankfort | 300,000 |
| Farnworth | 400,000 |
| Fenton | 400,000 |
| Friedenshutte | 500,000 |
| Furth | 400,000 |
| Freiburg | 200,000 |
| Goole | 250,000 |
| Glossop | 300,000 |
| Guildford | 300,000 |
| Gloucester | 1,250,000 |
| Gera | 300,000 |
| Grafton, N.S.W | 100,000 |
| Grieg | 300,000 |
| **Georgetown, U.S.A** | 250,000 |
| Gluckauf | 200,000 |
| Heywood | 600,000 |
| Holywood | 125,000 |
| Huy | 70,000 |
| Harrow | 250,000 |
| Harrogate | 250,000 |
| Halstead | 150,000 |
| Heilbronn | 200,000 |
| **Havana, Cuba** | 750,000 |
| Hastings | 1,500,000 |
| Huddersfield | 300,000 |
| " | 750,000 |
| " | 1,500,000 |
| Hof | 200,000 |
| Hampton Wick | 500,000 |
| Heckmondwicke | 500,000 |
| Haverfordwest | 100,000 |
| **Halifax, N.S.** | 350,000 |
| Hamm | 200,000 |
| Halle | 400,000 |
| Heidelberg | 300,000 |
| **Hartford, U.S.A** | 1,000,000 |
| Ilkeston | 300,000 |
| Inverness | 250,000 |
| Ilkley | 200,000 |
| Ilford | 100,000 |
| Kingston-on-Hull | 400,000 |
| Kiddermuster | 750,000 |
| Kidsgrove | 100,000 |
| Konigberg | 1,000,000 |
| King's Lynn | 300,000 |

**LONDON:—**

| | |
|---|---|
| The Gaslight and Coke Co.: | |
| Beckton | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 1,250,000 |
| " | 2,500,000 |
| " | 2,500,000 |
| Silvertown | 1,000,000 |
| Bromley | 2,000,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| " | 2,000,000 |
| " | 1,500,000 |

| LONDON—*Continued.* | Capacity. Cubic feet per day. |
|---|---|
| Shoreditch | 2,500,000 |
| Pancras | 1,500,000 |
| " | 1,500,000 |
| Pimlico | 2,000,000 |
| Nine Elms | 3,000,000 |
| " | 3,000,000 |
| South Metropolitan Co:— | |
| Greenwich | 3,000,000 |
| Woolwich | 400,000 |
| Vauxhall | 3,000,000 |
| " | 3,000,000 |
| Lea Bridge | 300,000 |
| West Ham | 1,500,000 |
| Leeds | 2,000,000 |
| " | 3,000,000 |
| " | 3,000,000 |
| " | 3,000,000 |
| " | 3,000,000 |
| " | 2,000,000 |
| Leominster | 150,000 |
| Leiden | 500,000 |
| " | 600,000 |
| Liverpool | 2,000,000 |
| " | 2,000,000 |
| " | 2,000,000 |
| " | 2,000,000 |
| " | 2,000,000 |
| " | 3,000,000 |
| Lincoln | 1,000,000 |
| " | 600,000 |
| **Lowell, U. S. A** | 1,000,000 |
| **Louisville** " | 1,500,000 |
| Long Eaton | 500,000 |
| Lilie | 900,000 |
| " | 450,000 |
| " | 750,000 |
| " | 250,000 |
| " | 250,000 |
| Luckenwalde | 330,000 |
| Liegwitz | 300,000 |
| **Lincoln, U. S. A** | 250,000 |
| **Lawrence** " | 500,000 |
| **Lynn** " | 300,000 |
| Lyons | 1,500,000 |
| Maidstone | 1,000,000 |
| Marseilles | 1,500,000 |
| " | 1,500,000 |
| Mons | 500,000 |
| Malines | 250,000 |
| Melbourne | 1,500,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| " | 1,500,000 |
| Manchester | 2,500,000 |
| Middleton | 400,000 |
| Manley, N. S. W | 100,000 |
| **Minneapolis, U. S. A** | 750,000 |
| Magdeburg | 300,000 |
| **Memphis, U. S. A** | 750,000 |
| Nottingham | 1,250,000 |
| " | 2,500,000 |
| " | 2,500,000 |
| " | 2,000,000 |
| " | 1,500,000 |
| " | 2,000,000 |
| **Newport, U.S.A** | 430,000 |
| Newmarket | 150,000 |
| **Newark, U.S.A** | 680,000 |
| Northfleet | 200,000 |
| **New York, U.S.A** | 2,000,000 |
| Nice | 600,000 |
| Newcastle, N. S. W | 200,000 |
| Numea, " | 100,000 |
| Namur | 250,000 |
| Newark | 350,000 |
| Oldbury | 500,000 |
| Otley | 200,000 |
| Oswestry | 250,000 |

| | Capacity. Cubic feet per day. |
|---|---|
| Ober Schlesian | 1,500,000 |
| Otto & Co.'s Coke Works | 1,500,000 |
| Plymouth | 2,000,000 |
| Parramatta, N. S. W | 100,000 |
| Prescott | 150,000 |
| **Providence, U.S.A** | 750,000 |
| " | 750,000 |
| Plauen | 300,000 |
| " | 300,000 |
| Portsmouth | 2,500,000 |
| " | 2,500,000 |
| **Pittsburgh, U.S.A** | 1,500,000 |
| **Portland,** " | 560,000 |
| **Pawtucket,** " | 500,000 |
| **Quebec** | 250,000 |
| Radcliffe | 750,000 |
| Rouen | 250,000 |
| Ramsgate | 1,000,000 |
| Reigate | 200,000 |
| **Richmond, U.S.A** | 250,000 |
| **Roxbury,** " | 500,000 |
| Runcorn Soap Co | 20,000 |
| Rockhampton, N. S. W | 125,000 |
| Richmond | 1,500,000 |
| Reading | 2,000,000 |
| Reichenbach | 200,000 |
| Salford | 1,750,000 |
| " | 1,750,000 |
| " | 1,750,000 |
| Smethwick | 750,000 |
| Sydney, N. S. W | 1,000,000 |
| " | 1,000,000 |
| " | 2,500,000 |
| " | 50,000 |
| " | 50,000 |
| Sunderland | 1,500,000 |
| **St. Josephs, U.S A** | 250,000 |
| Spa | 100,000 |
| Sevenoaks | 300,000 |
| St. Petersburg | 2,000,000 |
| " | 1,500,000 |
| **St. Louis, U.S.A** | 2,000,000 |
| " | 2,000,000 |
| " | 1,000,000 |
| **Laclede** | 1,000,000 |
| Silesian Coal Co | 600,000 |
| **San Francisco, U.S.A** | 2,000,000 |
| " | 2,000,000 |
| Sheepbridge Coal Co | 40,000 |
| Stettin | 200,000 |
| Singapore | 300,000 |
| Sutton | 500,000 |
| Tonbridge | 150,000 |
| Tipton | 400,000 |
| Tottenham | 1,000,000 |
| **Toledo, U.S.A** | 750,000 |
| **Toronto** | 1,000,000 |
| Uxbridge | 300,000 |
| **Valparaiso** | 500,000 |
| West Bromwich | 1,000,000 |
| Willenhall | 250,000 |
| Weston super-Mare | 500,000 |
| Waltham | 150,000 |
| Wormwood Scrubs | 300,000 |
| **Williamsburg, U.S.A** | 600,000 |
| " | 600,000 |
| Wellington | 150,000 |
| Warwick | 300,000 |
| **Wheeling, U.S.A** | 500,000 |
| Walker | 300,000 |
| Westgate | 100,000 |
| **Wilmington, U.S.A** | 500,000 |
| Windsor, N. S. W | 100,000 |
| Wolverton | 100,000 |
| Wellington, N. Z | 250,000 |
| Whitchurch | 175,000 |
| **Washington, U.S.A** | 2,000,000 |
| Wallasey | 750,000 |
| Weimar | 150,000 |
| Wurzen | 200,000 |
| **Worcester, U.S.A** | 750,000 |
| Yeadon | 500,000 |
| Yeovil | 250,000 |

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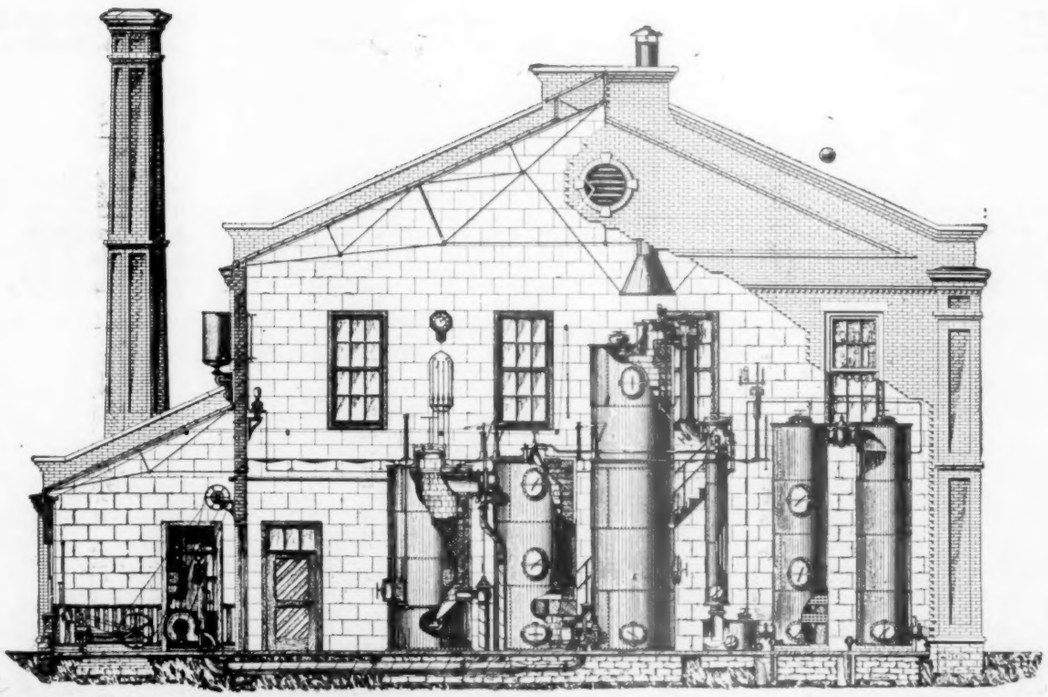

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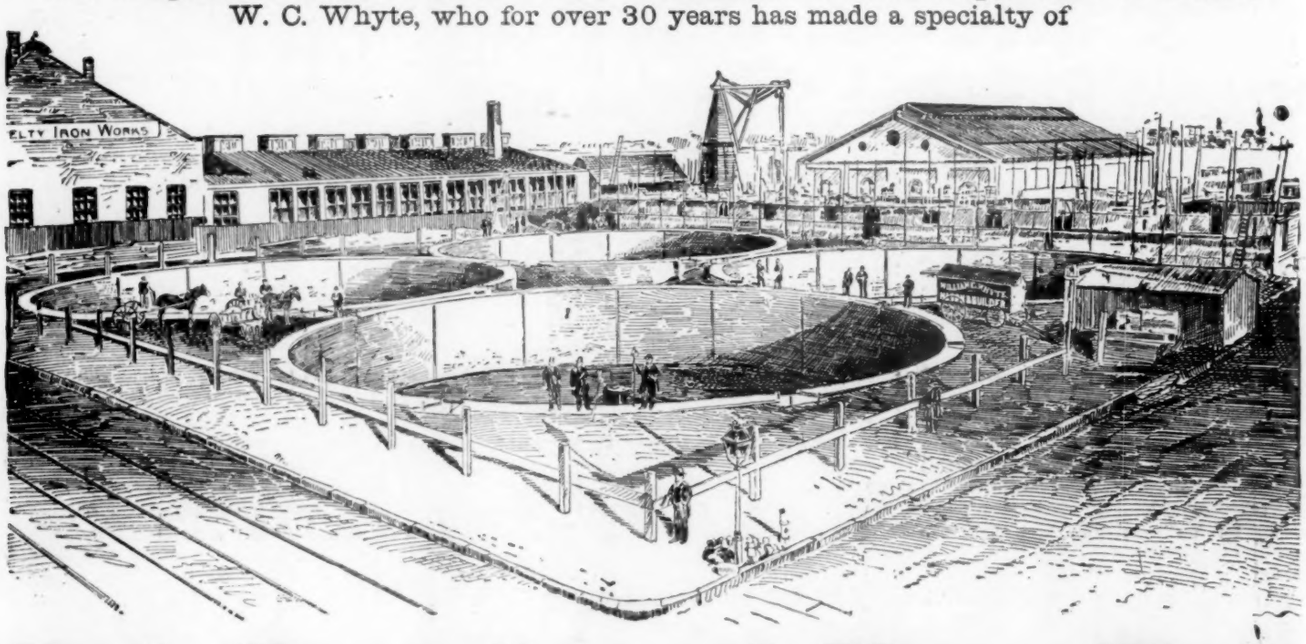


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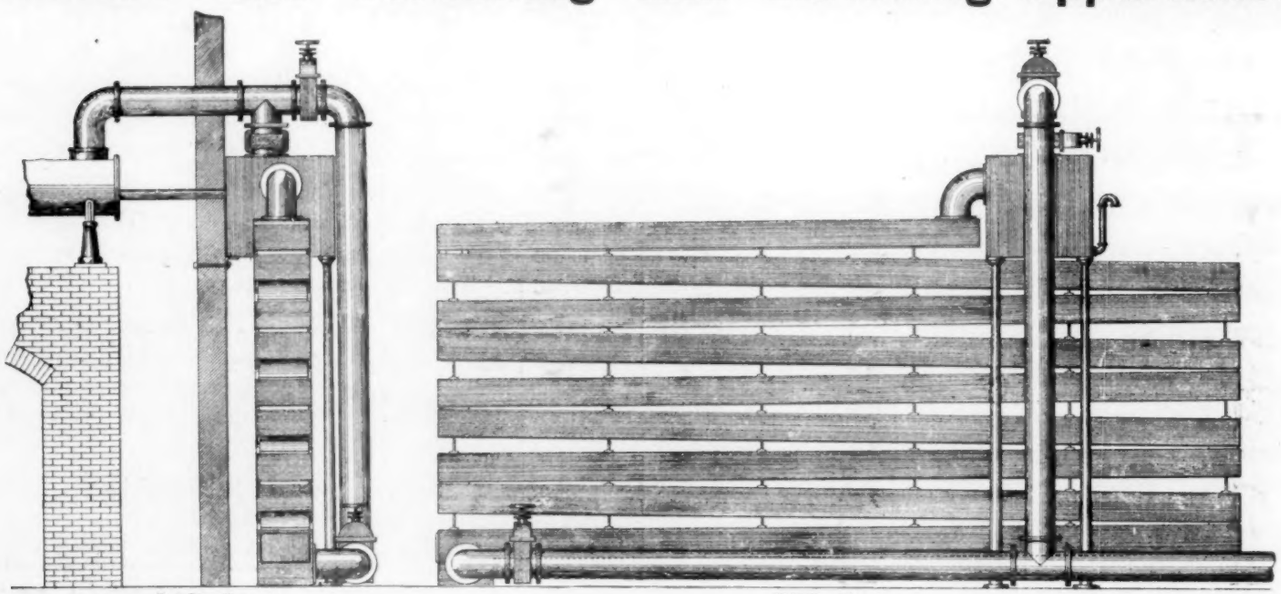

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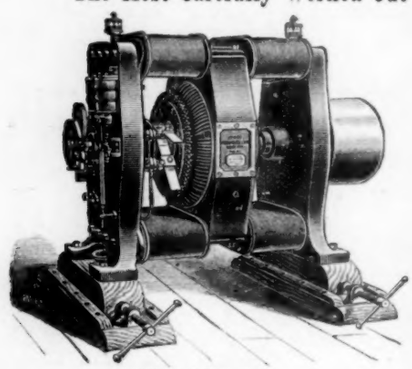

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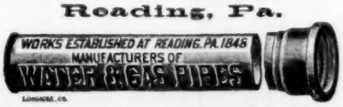


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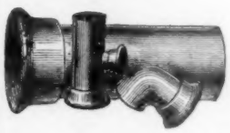

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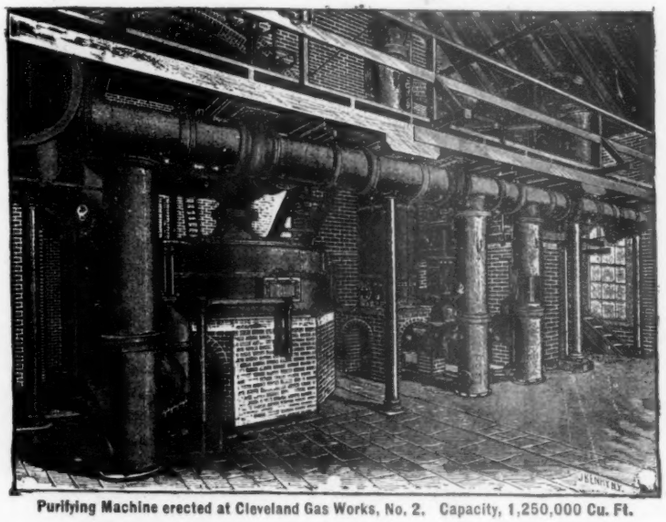

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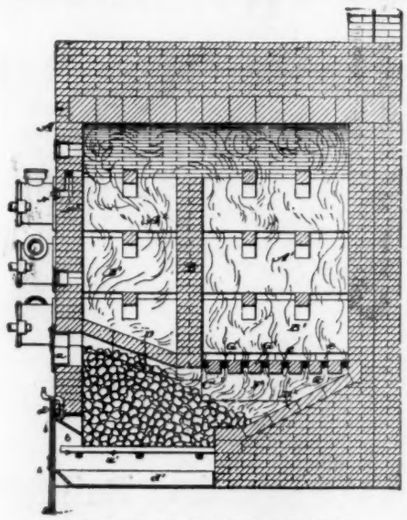

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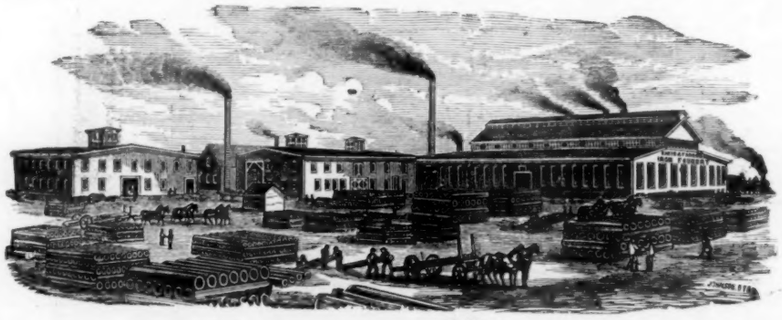

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with our long years of experience in the business,

**WE CAN GUARANTEE YOU SATISFACTION.**

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Triple Double, & Single-Lift
**GASHOLDERS.**

Iron Holder Tanks.

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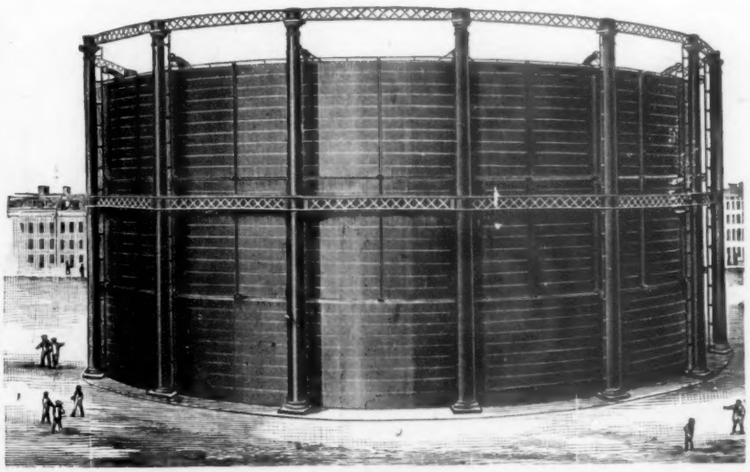

**PURIFIERS.**

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## The Wilkinson Water Gas Process.

**THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.**

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Gas Works Designed and Constructed.

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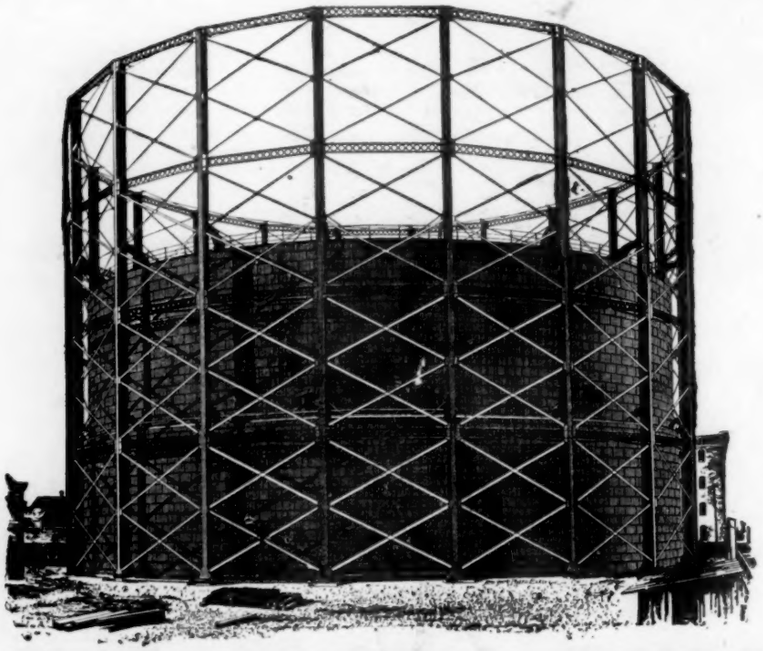

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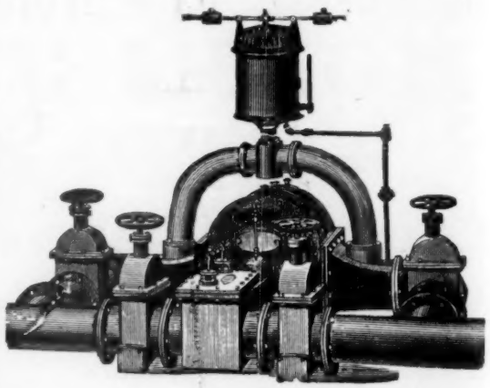
## Machinery & Apparatus for Gas Works



**Drawings, Plans, and Estimates Furnished for the Improvement, Extension, or Alteration of Gas Works, or for the Construction of New Works.**

Mackenzie's Patent Rotary and Steam Jet Gas Exhausters, Governors, Compensators, Condensers, Washers, Scrubbers. Isbell's Patent Automatic Street Pressure Governor, Gas and Water Valves, Hydraulic Main Dip Regulator, Bench Castings, etc. Purifying Boxes and "Standard" Scrubbers. Isbell's Patent Self-Sealing] Retort Doors.

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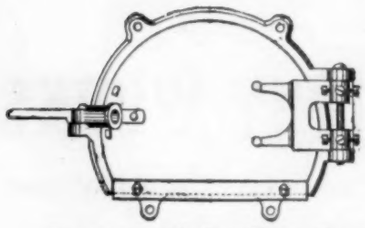
CLOSES ABSOLUTELY TIGHT & IS LOCKED BY A CAM LEVER. ALL NECESSARY ADJUSTMENT FOR WEAR PROVIDED.



Brenner Self-Sealing Retort Door.

BUILT BY

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WILLIAM B. LUNDIE, Superintendent of the 42d Street Station of the Consolidated Gas Company, of New York, writes, under date of Jan. 4, 1889:

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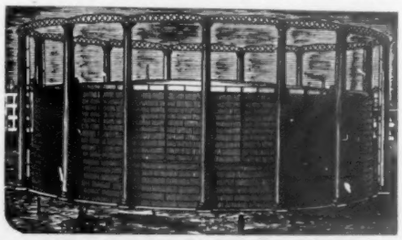
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Plans and Estimates Furnished.

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This Colliery is located at **SCOTT HAVEN, PA.**, in the center of the Youghiogheny Gas Coal District, and produces the **ONLY RELIABLE YOUGHIOGHENY COAL** for gas purposes. (See Map on p. 87 of this JOURNAL, Feb. 16, '85.)

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# BRECKENRIDGE CANNEL,

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Within the past two years we have delivered this Cannel to over **ONE HUNDRED COMPANIES IN THIRTY-THREE DIFFERENT STATES**, and it is now in use in some of the large Gas Works

**On the Continent and in South America,**

where it successfully competes with the Australian Shale. It is the **ONLY AMERICAN GAS CANNEL** of sufficiently high grade to warrant **EXPORTATION TO EUROPE AND SOUTH AMERICA**, and it is the only economical substitute for **OIL OR NAPHTHA.** **ONE GROSS TON** will produce

**10,000 Cubic Feet of 75 Candle Gas,**
**or 12,500 " " 60 " "**
**or 15,000 " " 50 " "**
} equal to { **750,000 Candle Feet of Gas, and 26 Bushels of merchantable Coke weighing 900 Pounds**

This is the **ONLY GAS CANNEL** that will produce a **REALLY MERCHANTABLE COKE.** It can be delivered in parcels of one carload or more to any point in the United States or Canada. Cargo shipments of any size required can be made from **NEW YORK, PHILADELPHIA, BALTIMORE, or NEWPORT NEWS.** Samples will be sent and particulars of price, etc., forwarded upon application to above address.

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**Unequaled as Gas Enrichers.**

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**FOR ENRICHING COAL GAS.**

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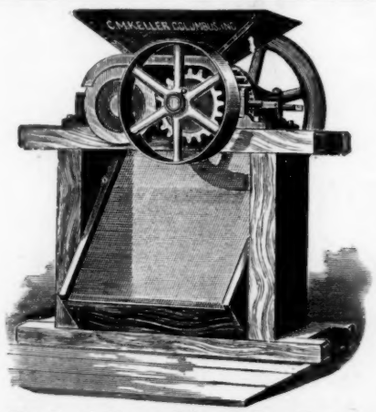


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**SIMPLE, STRONG, AND DURABLE.**

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**Correspondence Solicited.**

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The most complete work on Coal Gas ever published.

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Patent Cluster Lanterns for Street Illumination.

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WE REPAIR ALL KINDS AND MAKES OF METERS, AND THE WORK GUARANTEED.

High Pressure Meters for Natural Gas, in Iron Cases, guaranteed to stand 300 lbs. Pressure. Gas Cooking and Heating Stoves, Hot Plates, Cake Griddles, Waffle Bakers, Boiling Stoves, Laundry and Tailors' Iron Heaters. Hotel and Cafe Ranges a Specialty.

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**Established 1849.**

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WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
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SUGG'S "STANDARD" ARGAND BURNERS,
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Wet Meters, with Lizar's "Invariable Measuring" Drum.

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**REPAIRING DEPARTMENT.**—We employ a special force of skilled workmen repairing meters of **all makers.**

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Station Meters (square, cylindrical, or in staves), Glazed Meters, King's and Sugg's Experimental Meters, Lamp Post Meters, etc., etc. Meter Provers (sizes 2, 5, and 10 feet), Pressure Gauges of all kinds, Pressure Registers, Pressure and Vacuum Registers, Pressure Indicators (sizes 4, 6, and 9 inch), King's Pressure and Vacuum Gauges, Dry and Wet Center Seals, Dry and Wet Governors, Exhauster Governors, Photometers of all descriptions. Letheby's Sulphur and Ammonia Test Apparatus complete. Also, Testing and Chemical Apparatus of all kinds, and of the most perfect description, for all purposes relating to Gas.

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**Goodwin's Improved Lowe's Jet Photometer.** **Agents for Bray's Patent Gas Burners and Lanterns.**

Special attention to Repairs of Meters and all Apparatus connected with the business. All work guaranteed first-class in every particular. Orders filled promptly.

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## D. McDONALD & CO.,

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STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS, PRESSURE GAUGES, ETC.

**Also STAR GAS STOVES, RANGES, and HEATING STOVES.**

We use only the very best materials, and employ the most skilled labor, and by our long experience (36 years) and personal supervision of every detail, we feel justified in assuring the public that our goods will give perfect satisfaction. Every Meter emanating from our establishment will bear the State Inspector's Badge, and will be fully warranted by us. Our Annual and Calendar will be sent to Gas Companies upon application.

# GAS INTO POWER,

BY THE

# OTTO GAS ENGINE.

**GAS POWER.—A Source of Revenue** to Gas Companies ready to engage in Electric Lighting, building of Water Works, Electric Street Railways, etc.

**Coal for producing Gas is less in amount** than that for producing Steam, both being measured on an equal amount of work performed. And, further, with Gas,

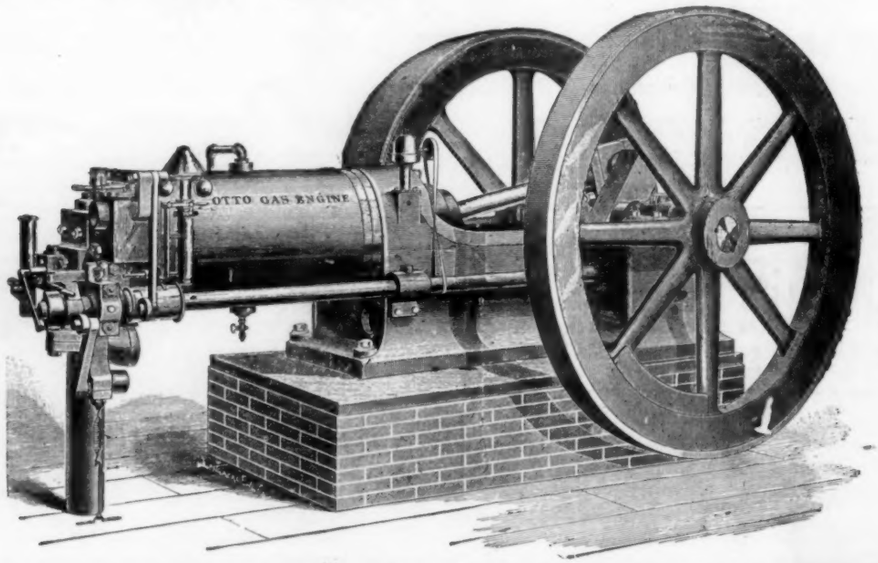
**50 to 90 per Cent. of Value of Coal is Returned**

by sale of Coke and Tar, according to the market value of these products.

**Labor** for handling fuel is **reduced,** by its becoming centralized and confined to the gas house, and frequently has not increased after the addition of a power station.

With Gas Power, **cost of fuel** is strictly **limited** to the time of use.

MANY VALUABLE AND RECENT IMPROVEMENTS.




SIZES 1-3 to 100 HORSE POWER.

**Wherever Gas Companies tried Gas Power with Steam Power together in one Station, the use of Steam was subsequently abandoned or restricted, and Gas Power made to take its place.**

Where Gas Companies adopt Gas Power for Electric Plants, Water Works, Sewerage, etc., they not only choose **the most economical power for their use,** but secure to themselves the **numerous advantages of increased production,** without increase of expense, and benefit thereby their entire manufacture. They induce consumers, by their example, to abandon Steam for Gas Power, and, by establishing special rates, make

**Gas Power the Leading Power of To-Day,**

AND SOLVE AT ONCE THE QUESTION OF FUEL GAS.

## "Otto Gas Engine Works,"

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